By DEANE G. CARTER
and KEITH H. HINCHCLIFF

FAMILY HOUSING

This book has:

Language and illustrations suited to the non-technically trained

The house-planning approach

An entire chapter on the farmhouse

A special consideration of remodeling

A discussion of construction, materials, equipment, and costs sufficient to afford an understanding of their importance

Information on public problems and influences

A problem list as a guide to applying principles to local situations

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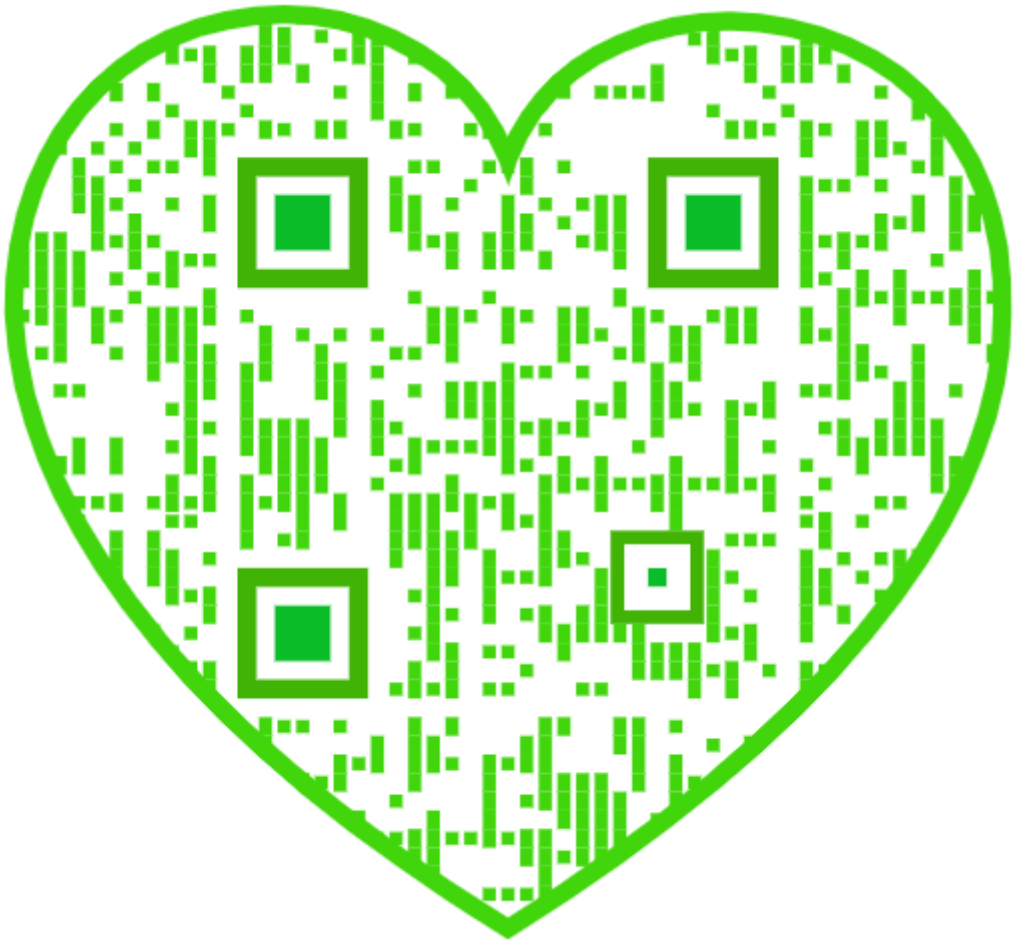
Tells how to make your house more of a home. Directed at the non-professional, *Family Housing* is a step-by-step analysis of home planning. It explains everything from building to remodeling, from fire-safety to farmhouses.



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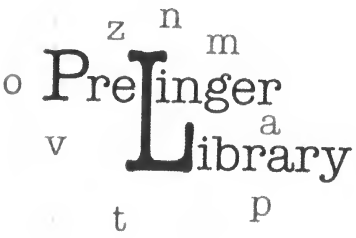

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Family Housing

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UNIVERSITY OF ILLINOIS

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Preface

This book is concerned with housing and house planning as they relate to family living. It is designed as a textbook for college students and as a reference for home economists, teachers, and others having a personal or professional interest in housing the family. Its purpose is to develop an understanding and an awareness of housing problems and to provide the information needed for their solution.

Although professional, industrial, and public aspects of housing have received much consideration, little attention has been given to housing as it concerns the home economist, the homemaker, and the family members who enjoy the benefits of good housing or suffer from mistakes of planning or judgment.

In deciding on the contents of the book, first consideration was given to topics of the most interest and value in planning the single-family house. They include the arrangement and use of space, functional requirements, and the adaptation of basic problem solutions to individual needs. Other topics are discussed sufficiently to define and clarify them in relation to family housing; but technical detail has been avoided. Each topic might be expanded almost indefinitely; indeed, entire volumes have been written on subjects indicated by the chapter headings.

The text material and illustrations were derived from many sources and combined with the authors' experience in consultation, design, construction, research, teaching, and extension education. Mr. B. H. Mewis reviewed the first draft of the manuscript and gave helpful criticism. In the division of work, the text was written by Deane G. Carter; the photographs were assembled and the drawings were made by Keith H. Hinchcliff.

Deane G. Carter
Keith H. Hinchcliff

Urbana, Illinois
January 2, 1949

Contents

CHAPTER		PAGE
1.	INTRODUCTION Statement of problem. Housing goals and limitations in planning. Making choices. Public aspects. Planning procedure.	1
2.	PUBLIC PROBLEMS OF HOUSING Influences, controls, regulations, and conditions. Examples of conditions, ways of making improvement. Public policies and public services. Housing research.	8
3.	RESOURCES FOR PLANNING Local resources, trade literature, public information, and federal agencies. Plans, models, and other aids. Delineation and drafting.	29
4.	APPROACH TO HOUSE PLANNING Functional planning. Primary areas for recreation, relaxation, and occupation. Plan patterns, adapting plans and avoiding errors. Personalizing, judging, and analyzing house plans.	44
5.	KITCHEN AND WORKROOM Concepts. Planning the equipment. Kitchen types, measurements, plans, and arrangement. Selecting equipment. The workroom.	57
6.	LIVING AND SLEEPING AREAS Variable features. Living room and supplementary areas. Dining room, bedrooms, bathroom, and closets.	75
7.	GENERAL PLANNING PROBLEMS Choices to be made. House size and number of stories. Attic, basement, garage, and porches. Chimneys, fireplaces, windows, and doors. Appearance factors.	90
8.	PLANNING FOR REMODELING Needs and purposes of remodeling. Evaluating the house. Facts needed. The remodeling program.	109
9.	FARMHOUSES Why requirements vary. Comparing urban and farm houses. Points of similarity. Special farmhouse plan features. Location. Planning services.	122

CHAPTER PAGE

10. PLANNING HOME EQUIPMENT 135
Needs and problems. Electric service, wiring, and planning. Facilities for hygiene, water supply, plumbing, and sewage disposal. House heating.

11. PROTECTIVE QUALITIES 147
Hazards. Accident prevention, health safeguards, comfort, fire safety, and moisture control.

12. BASIC MEASUREMENTS 159
Standards, modular co-ordination, and conventional measurements. Vertical measurements. Roof pitches. Stairs and steps. Openings. Structural dimensions and space allowances.

13. HOUSE STRUCTURE 170
Purpose. Types: prefabrication and conventional. Order of procedure. Definition of parts: frame types and parts, and other structural elements. Structural defects.

14. CHOOSING MATERIALS 192
General types. Reasons for choices. Describing materials. Specifications. Lumber, concrete, other masonry, building sheets, insulation, roofing, and miscellaneous materials.

15. COSTS AND MATERIAL QUANTITIES 208
Cost factors. How costs vary. Ways to reduce costs. Cost guides and approximate estimates. Making precise estimates. Materials and units. Methods of calculation. Listing materials from plans. Quantity list.

16. ECONOMIC AND FINANCING PROBLEMS 229
How much to invest. What rent pays for. Cost of owning a home. Financing: FHA-insured loans, building and loan associations, and farm credit. Loans and security. Repayment. Amortization.

17. ACQUIRING HOME OWNERSHIP 239
Conditions and problems. Resources, risks, and advantages. Contacts to make. Ways to acquire ownership. Legal steps necessary. Business of building: contracts and documents. Selecting a site. Judging a house.

APPENDIX A. HOUSING PROBLEM STUDY 253

APPENDIX B. REFERENCES FOR HOUSING STUDY . . 257

INDEX 261

CHAPTER 1

Introduction

Housing is both a personal problem of attaining a satisfactory home and a public problem of meeting the living needs of all families. Although planning is the first step toward the solution, planning goes far beyond the blueprints of the house itself. It must take account of levels of income, building costs, regulations, controls, materials, methods of construction, available services for planning and building, climate, location, and economic conditions.

Many decisions have to be made on the basis of local situations which limit or determine what can be done. Choices must be made among different ways of meeting needs, depending on cost, value, preference, and other circumstances which affect each case. It is necessary to distinguish between the basic qualities of good housing and the variations that make one house different from another house.

Generally, the student's immediate interest is in applying his or her experience and knowledge of home life and family needs to the solution of personal housing problems. It is not necessary to be skilled in a professional or practical field of housing in order to plan effectively for family needs. However, it is essential to understand and appreciate good planning, to apply principles, and to reach valid solutions to problems of planning, building, and buying.

For these reasons, emphasis is given in this book to general principles, typical solutions, and basic information that can be adapted to the individual case. All available aids should be used in planning, not only from libraries and public sources but also from local architects, engineers, suppliers, and builders.

HOUSING GOALS

The first step in a study of housing is to establish desirable goals. Goals vary according to the individual family's experience. For example, a young family living in a trailer or converted barracks may have the modest goal of more space and greater convenience. Tenants may be willing to accept less desirable quarters in order to become owners. As one's income increases, it is natural for one

Univ. of Illinois, Small Homes Council

Figure 1. An "industry-engineered" house, built experimentally at the University of Illinois, illustrates a current trend in single-family housing. See Figure 119 for reversed floor plan.

to invest more to obtain higher qualities and more features of convenience and comfort.

Requirements for eating, sleeping, group activities, and housekeeping are the first goals—the basic functions or purposes of the house. In addition, the list of requirements may include other needs such as space for children's study, care of babies, entertainment, and hobbies. Other common goals include:

Convenience in performing normal housekeeping duties which require between 40 and 50 hours a week. About one half of the work time is spent in the kitchen. Other principal duties include routine care of the house, laundering, sewing, and care of children.

Safety measures that are necessary to protect the family and

its possessions. These include safe construction, facilities for health, and protection against fire and accident hazards.

Economic security which depends on one's ability to pay for a home and carry the cost of upkeep without hardship. As payments are made, the owner acquires a substantial equity, which has a cash value if he wishes to sell.

LIMITATIONS IN PLANNING

Good planning is not limited to the "dream" home often visualized at quality levels which cannot be attained. The very best thought is needed for planning the modest small house. Replanning an old house often calls for a livelier imagination than is needed to plan a new house. Ideas gained by practice in planning are helpful in choosing a house to rent or in building, buying, or remodeling.

It is always more interesting to plan a house as if it were to be "your own." Then personal needs can be analyzed, preferences considered, mistakes avoided, and wishes fulfilled in the plan. But the plan that meets your needs is almost certain to have many features that are equally suitable for meeting the needs of many other families, because houses are "alike" in more ways than they are "different." These similar characteristics are by far the most significant in planning. In fact, the best way to plan a personal house is to begin with a basic arrangement and adapt it to the individual need. It is most important to plan for *functional value*, that is, the quality which makes a house useful and livable for the typical family.

Constant compromise is necessary in planning, for one's ideals often conflict with realities. The best solutions can be found only if the obstacles are recognized and the many factors that influence housing are taken in account. Before beginning to plan and solve problems, one should consider the following facts:

Cost. Housing costs tend to increase rather constantly not only with a generally rising price level, but because people are demanding more convenience, higher quality, and new equipment.

Income. Income is a principal factor which limits the amount that can be spent and, consequently, the quality of housing. Only about one third of the families are in a financial position

Weyerhaeuser Sales Co.

Figure 2. A modest small home. An example of good conventional design at economical cost.

to have the housing they want regardless of cost. More than one half cannot afford the kind of houses described in popular terms as the "American standard." Better housing at lower cost is a major need.

Tenure. Only about one half the families in the United States own their own homes. Many do not have sufficient resources to buy or build; others dislike to assume the risks of ownership; or the nature of their occupation makes it inadvisable for them to own a home.

Planning and building. Relatively few people live in homes they themselves have planned and built. The "new house market" is limited to perhaps 15 per cent of the total. Most families rent, buy old houses and remodel them, or buy new houses after the construction is completed. Ownership is most often attained after the family is well established and has accumulated substantial savings.

Meeting emergencies. In many ways, housing is always an "emergency" problem in some localities and for some families.

Current high costs prevent many families from owning their homes, and it is increasingly difficult to find desirable houses for rent. The situation has led many young couples to overinvest, or to build cheap unsatisfactory small houses in order to have a place to live. Generally, it is not feasible for the young family to build a unit or a portion of a house with the idea of enlarging it later on. Yet when prices are high and materials and labor are scarce, this may be the best solution. The complete plan should be made, however, so that future additions will fit into the ultimate plan. The individual can ill afford to invest in emergency housing. Employers, large investors, and public agencies should assume most of the cost and risk of emergency housing.

Sources of plans. Most houses are built from standard plans or copied from houses already built. Comparatively few are individually planned by architects for the families that are to live in them. Many houses are prefabricated in a limited number of sizes and styles; good basic planning is particularly important in such cases.

Changing needs. Although a well-built house will last 40 to 50 years or even longer, family needs change frequently, and, therefore, families move from one house to another. One house is likely to be used by many families in succession, each with different needs. This emphasizes the necessity for typical or basic plans and for houses with space arranged so it can be used in various ways.

MAKING CHOICES IN HOUSING

This book deals primarily with the single-family house. It is assumed that home ownership is a desirable goal and that ideals for one's own home should be based on a relatively high, but practical, standard. It is realized also that an increasing number of families must forego ownership. Multiple houses—duplexes, row houses, and apartments—are necessary in cities because of high land costs, and because of the possibility of economy in the construction, upkeep, and management of large groups or units.

Within recent years new problems have arisen with the advent of house trailers, demountable houses, and prefabrication methods. Rapid changes have taken place in materials, construction methods,

equipment, and house types. Among the current trends and preferences in housing, the following are the most significant:

1. Prefabrication, both of complete houses and of parts and units.
2. Standardization of parts and equipment; more uniformity in style and plan; and less attention to formal or period styles.
3. Fast erection through the use of standard parts, lightweight materials, and power-operated equipment.
4. Improved equipment and appliances that provide more nearly automatic operation.
5. Smaller houses, fewer basements, and more one-story types.
6. Greater flexibility for adaptation to individual needs.

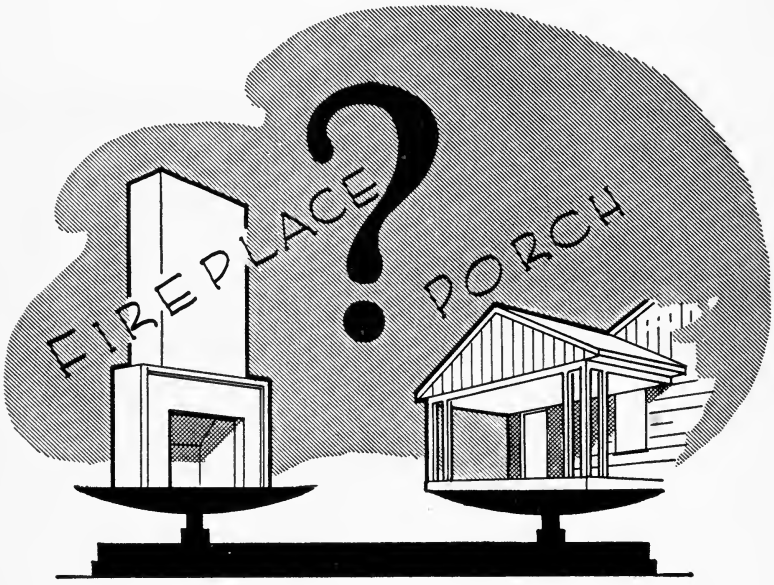


Figure 3. Weighing one need or choice against another is an important phase of planning.

Making choices is the most important part of planning. The many factors involved make it necessary to utilize many aids and sources of information as the basis for choices. The responsibility

finally rests with the wage earner, the housewife, and the family who pay the cost and assume the risks of ownership.

Choices should be based on careful evaluation; on the distinctions between the significant things and those which are less important; and on an awareness of what is functional, practical, economical, and satisfactory. The most intelligent choices are possible when one is able to analyze plans, compare costs and values, understand materials and methods of construction, and find alternate solutions demanded by conditions and circumstances.

HOUSING IS A PUBLIC PROBLEM

Problems such as housing shortages, high costs, financing methods, improvement needs, and community planning make housing a public issue as well as a personal problem. The immediate problems vary from time to time with changes in general conditions. Decisions must often be made on the basis of meeting an emergency or conforming to prevailing conditions rather than on long-time public or personal objectives.

As a result of increasing population, less-than-normal building from 1929 to 1934, and the limited construction during World War II, it was estimated that at least a million housing "units" a year for 10 years would be necessary to meet postwar needs. The highest rate of building in any previous year was in 1925 when less than a million units were produced. Therefore, housing is likely to be a major problem for many years.

PLANNING PROCEDURE

This book deals with housing first of all as a personal problem, which can best be solved by analyzing the house as a functional unit. After the general solution has been found, it is comparatively easy to make modifications to meet personal needs. This requires an understanding of the effect and influence of location, money resources, building costs, materials, essential equipment, and types of construction. Acquiring ownership, paying for housing, and safeguarding the investment are subjects for later treatment after the principles have been established. Because the personal solution is so directly affected by the public aspects of housing, it is necessary to consider the conditions, controls, legislation, and other factors that so often determine what the family can do.

CHAPTER 2

Public Problems of Housing

The conditions under which people live are a matter of public concern. Bad housing is associated with ill health, hazards to life and property, increased delinquency, and low real estate values. "Blighted" areas in cities and unregulated developments in suburbs or rural communities not only result in lowered standards but may also become sources of contamination, disease, and fire danger.

Because many families live in substandard houses, public attention should be directed toward remedial measures, such as community planning, reducing costs, enforcing adequate standards, and other means of attaining a national goal of better housing. Municipal, county, state and Federal governments or their agencies are responsible for enacting and enforcing legislation to safeguard against hazards, protect property values, eliminate undesirable conditions, and advance standards of housing.

Conditions of prosperity and depression and rapid changes in incomes and prices have a direct effect on housing. Both depressions and high building costs slow down construction which results in shortages and lowered standards. Emergency measures applied to housing often cause excessive costs, financial failures, and unsatisfactory conditions.

The individual has an interest in and a responsibility for the public aspects of housing. He should be able to determine the value of proposed programs and lend support to research and other activities essential to better housing. He can influence the adoption of practical standards and controls essential to the public welfare. His own housing situation is affected by public policy relating to finance, regulation, codes, zoning, and en-

Chicago Plan Commission

Figure 4. A design for a new residential neighborhood.

forcement. These factors are often more effective than the owner's preference in establishing his housing standards.

No single panacea will solve the many housing problems. Education and help in planning are needed. Many codes and regulations should be revised. Improvement is needed in building methods, construction standards, and community planning. Since this book is concerned with family housing, the following discussion is limited to public problems that most directly concern the individual family. Several excellent books deal fully with the public aspects of housing (see Appendix B).

HOUSING CONTROL AND REGULATION

Regular or routine controls established by law for the benefit of the public are most important to the home owner. They are necessary to safeguard the community and protect people and property. Lack of controls create fire hazards and may cause bad health conditions, contagion, epidemics, nuisances, and community deterioration.

Controls are usually established and enforced by local officials within the corporate limits of towns and cities. Some requirements are set by state or Federal action. Most regulations do not apply outside city limits, with the result that serious hazards and dangers exist in some communities. Laws in some states permit rural areas to establish and enforce controls on building, but only a few rural communities are "zoned." Farmers usually may build without restrictions other than may be required in connection with insurance protection, security for loans, or inspection before electric service is supplied.

ZONING. Cities are divided into areas or "zones" according to the types of construction permitted and the uses that may be made of property. In completely built-up sections, construction must be fire-resistant, and as nearly fire-safe as possible. Requirements vary in "fire zones" according to the hazards involved.

Zoning tends to segregate areas according to use for such purposes as business, light and heavy industry, apartments, and residential districts. This maintains about the same character of use throughout each community or district and prevents encroachment by undesirable developments. It should be noted, however, that rezoning may open older residential areas for business and commercial use. Public works departments of cities, planning

commissions, and citizen's groups can render valuable service by giving constant attention to zoning problems.

Codes. Most cities enforce codes or rules adopted to regulate materials, construction, standards for installation of utilities, and,

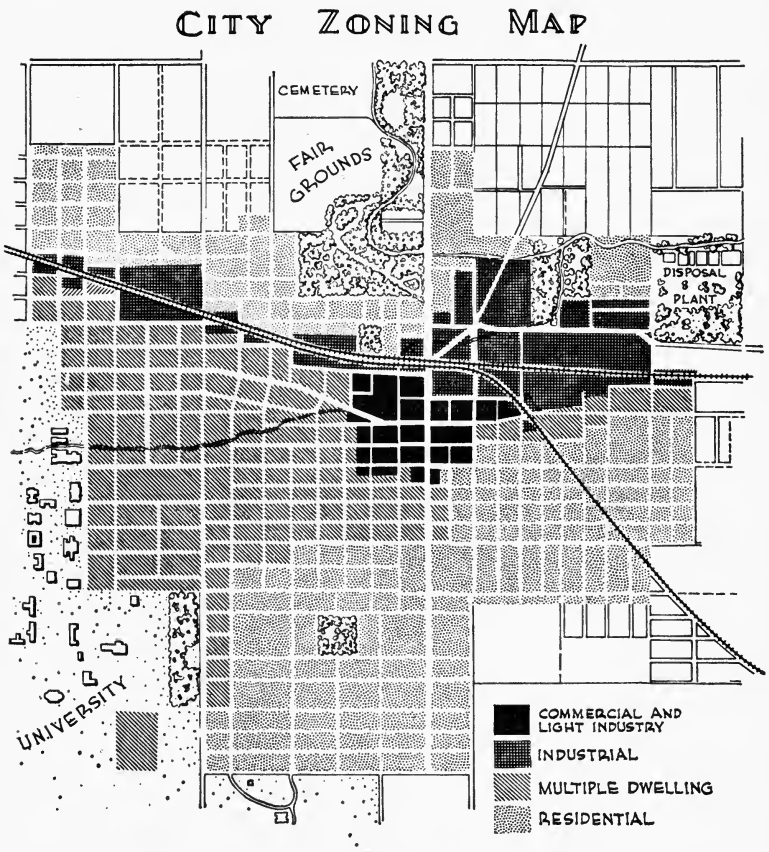


Figure 5. A typical zoning map of a small midwest city, showing major divisions according to permitted use.

to some extent, the architectural and engineering services that may be used.

As a rule codes are beneficial and in the public interest and are necessary to control the type and nature of housing in an area or subdivision. Codes are sometimes violated, however, by the

granting of special privileges that are not in the best interests of home owners. Furthermore, adequate professional service is not always used in preparing codes, and sometimes they are not revised often enough. As a result codes may contain unnecessary restrictions or prohibit methods and materials that should be permitted.

Restricted subdivisions. Property in residential areas may be restricted at the time it is sold to prevent construction or activities that are detrimental to the district. Minimum cost limits are often set for improvements; houses built in the area must have a specified value above a minimum in comparison with prices on a given date. Buyers should be able to comply with the conditions before buying or arranging to build in a restricted area.

Improvement districts. Areas or subdivisions may be organized into improvement districts by vote or by other legal procedure, for the purpose of getting paving, sewers, water lines, or other public works. Frequently, real estate developers install improvements before selling to individual buyers, and include the improvement costs in the sale price. In other cases, the purchaser may find that he must pay assessments to retire the debt for public improvements.

Permits and inspections. Where codes and zoning laws are in effect, it is necessary to obtain a permit to build, remodel, or make extensive repairs. The owner submits plans, description, cost estimate, and other information. If the improvement conforms to the legal requirements, the city authorities issue a permit. Separate permits may be required for utilities, necessary meters, and connections. Improvements for which permits are issued are examined by official inspectors whose duty it is to enforce compliance with zoning laws, building codes, and other regulations. Such inspections do not take the place of inspections of materials, construction, and workmanship which are made by the owner or his agent on contract work.

Other controls. Aside from public zoning or restrictions, additional controls may be required. Insurance agents are expected to examine properties both for fire hazards and fire-safe features that affect the insurance. Power companies may refuse to connect electric service until the wiring has been inspected and approved. Financing agencies may require specified standards before a loan is made.

HOUSING CONDITIONS

Controls and regulations generally do not improve the quality of existing housing. They serve only to prevent the recurrence of conditions found to be unsatisfactory or dangerous. Much of the housing in the United States either is not affected by controls or was built before the regulations were established. Many houses, perhaps 25 per cent or more of the total, are in such poor condition that they fail to meet common standards of adequacy.

PRINCIPAL NEEDS. Surveys, census data, and reports reveal many deficiencies in the quality and condition of housing. The principal deficiencies applying in some degree to housing in each area and region are: (1) overcrowding, (2) poor state of repair, (3) advanced depreciation, (4) lack of equipment, (5) hazards to health and safety, and (6) dangerous conditions from the standpoint of public welfare.

Surveys do not give a complete picture of housing needs, for they generally do not measure comfort, quality of furnishings, or the fitness of the house for family use. Observations will likely indicate, however, that poor structures and lack of equipment are associated with low qualities in other respects.

REASONS FOR PREVAILING CONDITIONS. Changes in neighborhoods may reduce house values so that it is not profitable to repair or remodel. Yet when the demand is strong, such houses continue to be occupied. Tenants are often compelled to accept low-quality housing, either because nothing better can be found or because they cannot afford to pay rent for a good house. Sometimes people are indifferent to their housing or are satisfied to neglect housing in favor of saving or spending for other things.

Economic conditions probably exert the most powerful influence on the condition of housing. In depressions, many cannot afford to own or rent good housing or are unable to spend enough to maintain their homes in good condition. In prosperous times the cost of housing goes up faster than income. Costs for land, materials, equipment, and labor are often unrelated to the earning capacity of the family that needs housing. The majority of families must limit themselves to the "used house" market both for renting and owning.

SOURCES OF INFORMATION. The principal information on housing conditions is derived from three sources: (1) the President's Con-

ference reports on home building and home ownership, published in 1932, (2) the Farm Housing Survey of 1934, made by the United States Department of Agriculture, and (3) The 1940 Census of Housing. Local surveys have been made in some communities by various agencies interested in housing.

Figure 6. A typical example of the need for housing improvement. For one remodeling solution, see Figure 86.

EXAMPLES OF CONDITIONS

The following brief statements are examples of the kind of information published on housing conditions:

SUBSTANDARD HOUSING UNITS. The National Housing Agency, reporting in its Bulletin 1, estimated that about 7 million nonfarm housing units were "substandard" in 1940. In making this estimate, it was assumed that units in cities were substandard if they had no private bath and toilet, or if they needed major repairs. In other areas houses were rated as substandard if they needed major repairs. Although a house is not necessarily unfit merely because it lacks a private bathroom or needs major repairs, these conditions are closely related to the need for replacement.

HOUSING DEFICIENCIES. Housing conditions in Illinois are not unusual. Surveys of other areas would likely show conditions

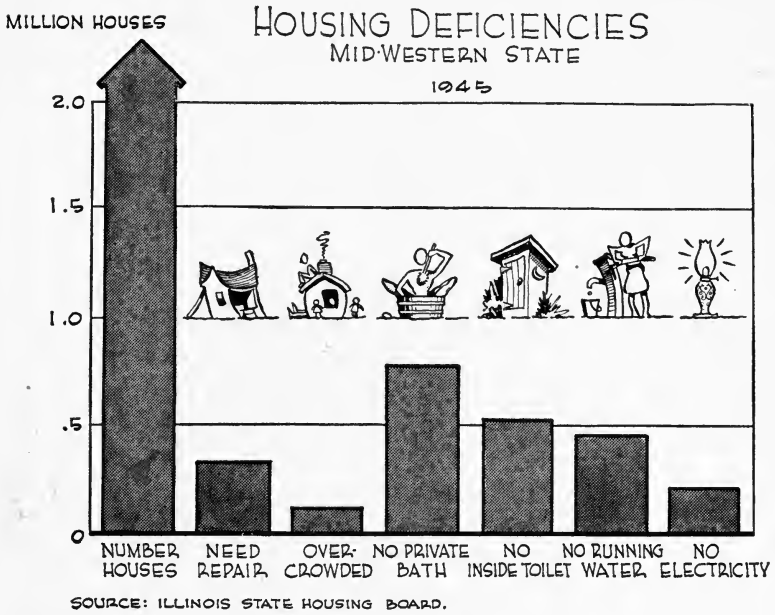


Figure 7. The 1940 census of housing and various surveys reveal conditions and needs.

that are similar or even less satisfactory. Yet data reported by the Illinois State Housing Board in 1945 indicate that, of the 2,280,826 dwellings in Illinois:

336,141 or 14.7 per cent, needed major repairs.
120,111 or 5.3 per cent, were dangerously overcrowded.
773,784 or 34.0 per cent, had no private bath.
538,513 or 23.5 per cent, had no indoor toilets.
460,277 or 20.2 per cent, had no running water.
227,949 or 9.8 per cent, had no electricity.

Farm housing. Housing needs on farms are shown by the 1934 farm housing survey. The averages reported by regions may not represent the typical condition in individual houses, but they do indicate the total need. Although the study was made in 1934, relatively little change occurred until after 1940, owing to conditions that prevented farmers from making normal improvements. Table 1 compares a number of significant factors of conditions in

the different regions. In addition to pointing out needs, the survey affords an interesting comparison of variations among the regions in such factors as house size, age, repair need, and equipment. The "index of condition" is a relative measure of the state of repair. It shows a low average of 44 out of a possible 100 score for the

Douglas Fir Plywood Association

Figure 8. Old house, typical of many in both urban and rural areas, which must be remodeled to salvage remaining value. See Figure 82 for appearance after remodeling.

structural condition of all farmhouses. Preferences are also indicated for such features as basements and two-story types.

Higher building costs and greater farm income during and after World War II enabled farmers to make up some of the deficiencies in farm housing. Extension of rural electric lines progressed rapidly, and the improvement of farm housing in general became evident immediately after the war. It was estimated by the U.S. Department of Commerce that about one billion dollars was spent by farmers in 1947 for new houses, repairs, and

remodeling, with indications that the same rate might continue. Census data reported in 1948 stated that 19 per cent of the farm dwellings needed major repairs, 10 per cent were overcrowded, 66 per cent lacked running water, and 80 per cent were without bath and toilets. The increase in number of bathtubs, cited as a typical improvement, was from 810,000 in 1940 to 1,507,000 in 1947.

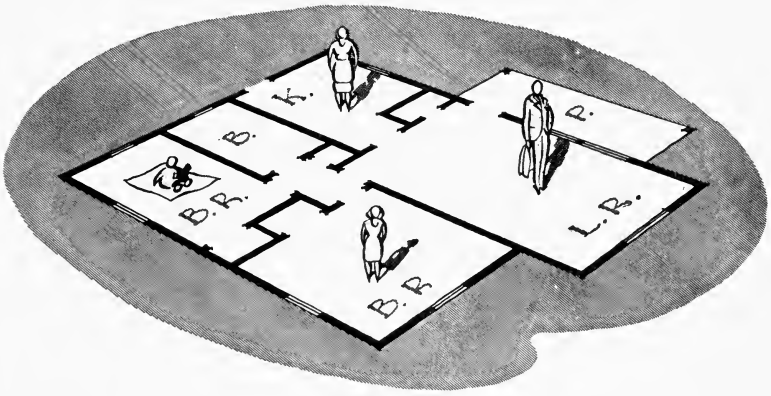


Figure 9. Usual space standard is for 1 room per person in the household.

IMPROVING HOUSING CONDITIONS

Low quality of housing, as indicated by surveys and measured by comparison with an assumed standard, is a serious national problem. Some disagreement exists in the definition of a reasonable standard. Even more uncertainty prevails as to the most effective methods of raising "substandard" housing to an adequate level. Opinion varies as to what constitutes an "adequate" house. Recommendations made in this book are intended to represent desirable standards of space, equipment, construction, and quality. It is certain that many families cannot attain these standards; modifications must often be made to fit personal circumstances and finances.

Definition of standards. It is generally agreed that a house should have as many rooms as there are persons in the household and that not more than two persons should share one bedroom. A family is overcrowded if the ratio is higher than 1.5 persons

TABLE 1. FARM HOUSING CONDITIONS IN THE UNITED STATES

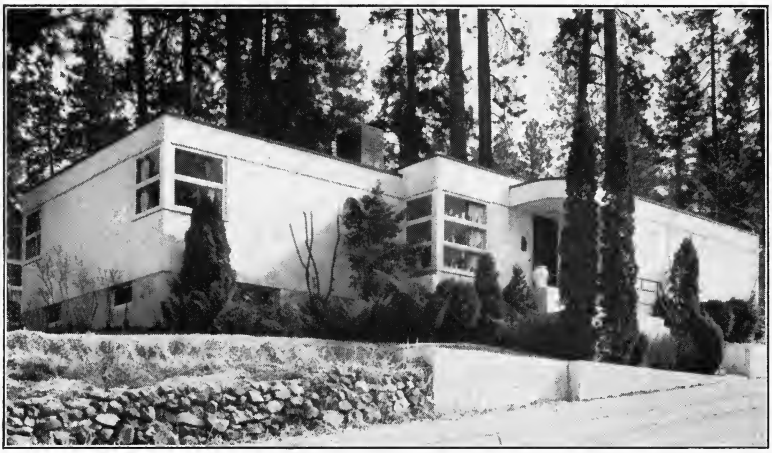
Based on Averages from the 1934 Farm Housing Survey, Reported in Misc. Pub. 323, U. S. Department of Agriculture

Item	Unit	U. S. Average	Averages by Geographic Divisions or Regions								
			New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific
Occupation											
Owners	per cent	50.1	85.6	76.0	61.1	51.8	46.7	43.0	39.9	59.0	72.7
Nonowners	per cent	49.1	14.4	24.0	38.9	48.2	53.3	57.0	60.1	41.0	27.3
Occupants	number	4.6	4.4	4.4	4.3	4.5	5.2	4.8	4.6	4.5	3.9
Houses											
Rooms	number	5.4	8.9	8.6	6.9	6.0	5.2	4.4	4.2	4.5	5.4
Bedrooms	number	2.8	4.2	4.6	3.5	3.0	2.8	2.4	2.2	2.1	2.7
1-story	per cent	56.2	5.7	5.6	17.6	30.7	63.8	77.0	90.1	72.8	64.4
More than 1-story	per cent	43.8	94.3	94.4	82.4	69.3	36.6	23.0	9.9	27.2	35.6
Frame	per cent	93.2	96.8	90.4	92.0	94.7	92.8	91.8	96.9	87.7	98.4
Unpainted	per cent	35.7	7.6	4.9	11.1	8.7	54.6	56.7	55.7	24.3	21.5
Condition	index	44.0	70.0	72.0	56.0	54.0	36.0	36.0	33.0	46.0	57.0

Age of houses, years											
Under 10	per cent	15.3	5.6	9.1	7.4	11.3	14.8	17.6	22.1	20.7	25.6
10–24	per cent	29.9	6.7	11.1	17.0	27.4	30.6	31.6	37.6	47.3	42.4
25–49	per cent	35.6	12.5	14.0	38.0	44.4	35.5	34.6	33.4	27.6	26.3
50 and over	per cent	19.2	75.2	65.8	37.6	16.9	19.1	16.2	6.9	4.4	5.7
Features											
Closets	per cent	58.5	95.5	94.3	79.8	72.2	53.7	42.3	34.3	58.8	80.8
	number	1.4	4.3	4.7	2.2	1.8	1.1	0.8	0.7	1.2	2.1
Bathroom	per cent	14.5	33.0	43.3	16.8	16.6	7.8	4.8	11.3	20.2	57.1
Basement	per cent	29.6	93.3	86.2	67.9	53.3	11.1	7.9	3.0	27.0	30.1
*Utilities**											
Electricity	per cent	13.9	55.0	66.1	20.5	10.1	8.0	1.4	2.5	23.3	71.0
Central heat	per cent	8.6	29.9	52.2	23.4	17.0	1.5	1.0	0.3	4.8	5.7
Piped water	per cent	16.4	55.2	54.0	18.1	15.8	8.9	4.1	13.1	26.8	69.9
Hot & cold water	per cent	7.7	26.3	38.7	8.8	8.0	4.0	2.2	1.7	13.2	45.7
Septic tank	per cent	4.5	9.6	10.4	5.6	4.1	2.8	1.0	1.8	4.6	28.3
Flush toilet	per cent	8.5	29.4	37.5	10.3	8.8	4.9	2.5	3.6	14.9	41.5
Bathtub	per cent	11.2	29.9	41.9	13.5	12.8	5.5	3.0	7.3	15.3	51.0
Kitch. sink	per cent	28.4	96.1	69.7	55.1	37.5	12.4	5.4	10.9	31.1	75.0

* Electric service has been extended to many farms since 1934: about 40 percent had electricity in 1940; other improvements have been made, but not in great numbers, due to the depression, followed by the war.

per room. Usual standards of sanitation and hygiene prescribe running hot and cold water, private bath, and indoor toilet. These are desirable facilities, for without them it is more difficult to maintain the proper level of health conditions. Minimum requirements include provision for heating the daytime living area of the house to a comfortable temperature in cold weather.



Douglas Fir Plywood Association

Figure 10. A well-designed "modern" house, high quality, and nicely fitted to irregular wooded site.

Standards that must be assumed in any definition of "adequate" include tight construction, smooth floors, finished walls and ceilings, and natural lighting. The quality of materials and construction should be sufficient to afford a useful life of at least 20 years to the very cheap house, and preferably the quality should assure 40 to 50 years usefulness. For safety and protection the requirements listed in Chapter 11 should be followed.

Levels of quality. More than one standard or level of quality is necessary to provide housing that can be afforded by various income groups. For convenience, the principal levels may be indicated as "minimum acceptable," "moderate," and "high." Such standards are only relative, and other names might be given to designate them. At "minimum" levels most emphasis is given to space, durable construction, and inexpensive equipment for convenience and sanitation. At "moderate" levels most of the

usual recommended practices can be followed but without elaboration. A "high" level may include such features as automatic heating, extra bath and toilet facilities, generous room sizes, and many built-in devices and items of equipment. The most serious problem is to raise "substandard" housing to a "minimum acceptable" level.

METHODS OF RAISING STANDARDS. Financing plans have been tried as a means of stimulating housing improvement among low-income families. Plans include small down payments, low interest rates,

Green Lumber Co.

Figure 11. Emergency housing. Built originally for war workers, many units of this type are used for veterans' housing. A familiar sight in college communities and in many cities.

and long-term repayment of loans. "Low-rent" housing units have been built in some areas, and the occupants are selected on the basis of need. Rents are charged according to the tenant's income. These projects are partly supported by contributions of Federal and local funds.

Education, planning help, and supervision of low-cost improvements offer many possibilities for assisting families in improving their own housing situation. Among the ways to reduce cash cost are: use of home labor for part of the construction, utilization of local materials, exchange of work among persons with various skills, co-operation in obtaining and using tools and equipment, and voluntary organizations to give help in planning and buying.

EMERGENCY HOUSING. In times of urgent demand for housing, or after a disaster such as fire, flood, or tornado, emergency

methods may be required. Such housing may or may not raise standards, but rather it provides living quarters which could not otherwise be obtained. Emergency housing generally consists of temporary or "duration quality" units, or trailers or demountable houses that can be moved. Temporary construction includes such things as post or block foundations, low-cost siding, semipermanent roofing, wallboard interiors, and plain standard millwork.

The danger in emergency housing is that temporary or semipermanent buildings frequently become "permanent" and are used until they deteriorate far below an adequate standard. Among those accommodated by emergency housing during recent years are itinerant laborers, war and defense workers, personnel of the Armed Forces and their families, college students, and war veterans unable to find other housing.

PUBLIC POLICY

Existing housing conditions and the widespread need for improvement have created much public interest and demands for government action. Public housing policy in the United States is not well defined. Some people urge that the Federal Government assume more responsibility for housing, as it has already done in education, transportation, and public health. This would mean that public or government agencies would control, direct, or strongly influence many phases of housing. Under some conditions public funds would be used to provide for families that could not afford good housing.

Others believe that housing should be entirely a private enterprise. They say that supply and demand, competition, profit motives, and consumer's choices would eventually result in the best standard that could be attained by each family, group, or class. Federal legislation and public programs already have affected housing. More public control is probable for the future; however, private interests will no doubt continue to build, finance, own, and control most of the housing units.

Housing was largely regarded as a private problem until after World War I. The Federal Government had no direct concern with family housing except at military establishments and on public lands and properties. Governmental influence has been increasingly important since about 1930. Demands for legislation and public action came as a result of financial and other obstacles

in the way of home ownership and the urgent need for better housing.

The "President's Conference on Home Building and Home Ownership," held in 1931 brought together many studies and reports on problems, conditions, and needs. The reports, published in a series of 11 volumes, covered financing, plan requirements,

Public Housing Administration

Figure 12. A "slum-clearance, low-rent housing project for low-income families" built under the provisions of the United States Housing Act of 1937.

social and economic factors, city planning, and other problems that focused attention on obstacles to better housing. Although the President's Conference was not sponsored by the Federal Government, many of the problems discussed in the reports later became the basis for Federal programs. Public programs relating to housing have the following objectives:

1. To extend knowledge of housing, and generally to promote better housing through education, research, and public service.
2. To meet urgent needs by means of "emergency" or permanent projects sponsored and partly or completely financed by public agencies.
3. To relieve depression conditions, stimulate business, over-

come unemployment, find investment for idle capital, and relieve financial distress.

4. To simplify methods and reduce costs of financing and to safeguard both borrowers and lenders.
5. To develop plans and programs for improving housing standards of low-income families, eliminating blighted areas, and encouraging privately managed housing projects.
6. To establish long-range programs to promote economy and better standards, eventually to provide a "decent home for every American family."

These objectives have been the basis for establishing various agencies and programs since 1930. The following are among the most significant:

Federal Home Loan Bank Board. Established in 1932 as an agency to facilitate home financing, insure safety in investments in building and loan associations, and give mobility to mortgage credit.

Tennessee Valley Authority. Although housing was a relatively minor part of this project, housing received wide recognition as one of the early phases of the program. Many planning ideas were utilized, and various materials and methods for improving housing and reducing costs were tried.

Resettlement Administration. Housing in this program included rural–urban "subsistence homesteads," resettlement of families moved from submarginal land, and establishment of new farming communities. Later replaced by other programs.

Farm Security Administration. Included housing improvement as part of the program for aiding tenant farmers in becoming owners and assisting those who could not otherwise obtain credit for buying farms and making improvements. Parts of program merged with the Farmer's Home Administration in 1946.

Home Owner's Loan Corporation. Essentially an emergency refinancing program to prevent foreclosure on homes and provide for maintenance and repair during depression years.

Federal Housing Administration. The primary function was to administer the insured-loan plan for private financing of

houses and to approve and inspect housing for insured loans.

United States Housing Authority. This agency directed "slum clearance" largely in urban areas, with the objective of providing low-rent housing and eliminating blighted areas.

National Housing Agency. A consolidation of Federal organizations that handled most Government housing activities relating to defense, war, and emergency prior to and during World War II.

Public Housing Administration. The agency currently (1948) responsible for financial and other public housing activities of the Government.

Public Housing Administration

Figure 13. Characteristic multiple-housing unit in public housing development, Greenbelt, Md.

OTHER PUBLIC LEGISLATION. In addition to the organizations and agencies just listed, various other acts, executive orders, and authorities were used to expedite housing and housing loans for veterans, control and conserve materials, fix priorities, issue permits, and otherwise direct housing activities during World War II. Important permanent legislation provides money for public research and education in housing.

PUBLIC SERVICES

A vast amount of information on housing is available from public and semipublic agencies. Bulletins, booklets, catalogs and sometimes plans may be obtained often without cost. Among the more important sources are the following:

Univ. of Illinois

Figure 14. Examples of published material on housing from various sources.

STATE COLLEGES AND UNIVERSITIES. Services include planning helps for rural housing through the Agricultural Extension Services and general information from various divisions and departments. Examples of special organizations for service in housing are the Purdue University Research Foundation and the University of Illinois Small Homes Council.

U. S. GOVERNMENT AGENCIES. These include the Bureau of Standards which makes tests and prepares basic specifications on structural materials and methods; the Forest Products Laboratory which deals with the utilization of wood and wood products; the Department of Commerce which promotes research and publications concerning building; the Public Health Service whose work pro-

motes health and sanitation; the Department of Agriculture that conducts research and publishes information on farm buildings and housing; and agencies concerned directly with financing, construction, and regulations, such, for example, as the Public Housing Administration.

ASSOCIATIONS. Several organizations, committees, foundations, and associations sponsor meetings, programs, and publications of interest in housing. Consult libraries or current periodicals for activities of these groups.

HOUSING AUTHORITIES. Public funds have been utilized in some states to assist local communities in clearing blighted or slum areas and provide management and other assistance in obtaining better housing. Public projects are administered by local "housing authorities." Some states have housing boards or commissions to expedite improvements. In most states corporations may be organized to build and operate housing projects under conditions that limit net profits to a specified low return on the investment.

HOUSING RESEARCH

Research in housing must be depended on to solve pressing problems of family needs, better comfort and convenience, greater economy, and improved materials and methods. Basic faults cannot be corrected so long as houses are individually designed and traditional construction practices are followed. House heating, for example, has been greatly improved by research on heating systems. Among the results are better placement of radiators and registers, general adoption of insulation in houses, adequate design of ducts and piping, forced circulation of warm air or hot water, more efficient burners, baseboard radiators, and panel heating. Currently, other heating problems are presented by the advent of radiant heating, concrete slab floors, solar heating, need for greater convenience in burning solid fuels, and the increased use of oil and gas for house heating.

Potential betterment in housing will be realized in many ways if research is adequately supported. Among the needs are: (1) studies in construction processes, especially to utilize machines, equipment, mass-produced units, and new building techniques to reduce labor and speed up construction; (2) development and

utilization of new materials or combinations of material to produce sizable construction units easily put in place; (3) co-ordination in design, especially the development of standard units made to exact measurements; (4) studies of family living activities, family needs and preferences; (5) analysis of time and motion in various household activities, and design of house areas for convenience and efficiency; (6) study of requirements of farmhouses; and (7) the development of specifications that can be adapted readily to various situations.

Many institutions are engaged in research on specific problems, such as equipment, paint, moisture control, lighting, use of materials, prefabrication, construction methods, and plan requirements. As results become available, designers will be able to apply findings and produce better and more economical houses.

An illustration of the trend is afforded by the housing program at the University of Illinois. Housing research is co-ordinated in a "Small Homes Council." Associated are several industries which support studies in utilization of fuels, house heating, construction methods, electric equipment, and house design. Individual departments also conduct independent studies. Through Federal grants, research is conducted in co-operation with the U. S. Department of Agriculture and with other state experiment stations. With support from industrial trust funds, research foundations, and institutes, several universities and private organizations are well organized for research on the many housing problems.

CHAPTER 3

Resources for Planning

The housing objectives, goals, choices, and situations outlined in Chapters 1 and 2 serve to reveal the many-sided nature of the problem. Solutions can be found only by studying basic principles and applying them to various actual conditions. Information must be gathered from many sources and applied to the problem at hand.

Information from people in the community often saves time and trouble and gives an idea of housing costs and methods. Bulletins, catalogs, and booklets should be used as a source of helpful information. Perhaps the most valuable resource is one's ability to read and understand plans and to make scale drawings and sketches of houses, rooms, arrangement of furnishings and equipment, and parts of construction.

Before taking up the principles of house planning, it is important to examine the resources for planning, find ways of obtaining helps, and learn to make essential drawings.

PLANNING RESOURCES

What is done about housing in any community is influenced very largely by local conditions. For this reason local information should be depended on for facts about costs, labor conditions, available materials, building practices, and regulations. Unless an architect is employed to take full responsibility, the owner must talk to many people to gather the needed facts.

The following list suggests ways of utilizing planning helps available within the community:

1. Measure the size of rooms, hallways, closets, stairs, furniture, and equipment in homes and residence halls. This will give an idea of commonly used measurements.

2. Study or "survey" several houses for a comparison of sizes, equipment, number of rooms, and other features.
3. Observe houses during the course of construction. This is an excellent way to study full-scale houses, methods of construction, and use of materials.
4. Attend "open house" and model displays which exhibit new houses, equipment, and furnishings. This gives a good idea of features that appeal to buyers.
5. Visit stores, lumber yards, and appliance shops to study materials and equipment.
6. Utilize the services offered by public utility companies in planning wiring and lighting; consult heating contractors who make "comfort surveys"; visit paint stores that have models and charts to aid in selecting color combinations; and attend appliance and equipment demonstrations.

Trade literature. Commercial booklets and catalogs are published to promote the sale of the manufacturer's products, and so naturally the advantages of each brand are emphasized. Such literature is especially useful for comparing products and keeping up-to-date on new developments. Trade associations representing an entire industry supply information and make suggestions for the best use of their products, regardless of trade-marks or brand names.

Architects, engineers and contractors generally have current annual editions of "Sweet's Architectural Catalog" which contains specifications and construction data. Popular magazines give much space to house plans, household equipment, and other items of interest in house planning.

Public information services. Federal and state agencies conduct research, publish bulletins, and sometimes provide educational service to communities and interested groups. Following are examples of these agencies and the kind of service or information supplied: State colleges and universities supply the most complete assistance through the extension services of the colleges of agriculture. Staffs include specialists in such fields as landscape planning, home management, home furnishings, electrification, and house planning. Bulletins and circulars are distributed (usually free), and blueprint plans are available at cost from most state

colleges. Although the work of the extension service applies especially to farm and rural situations, much information of general interest is available. In addition, many colleges and universities supply information and maintain services that apply to all homes. Among them are "visual aid" services, program planning suggestions, lecturers for special-interest groups, and public demonstrations.

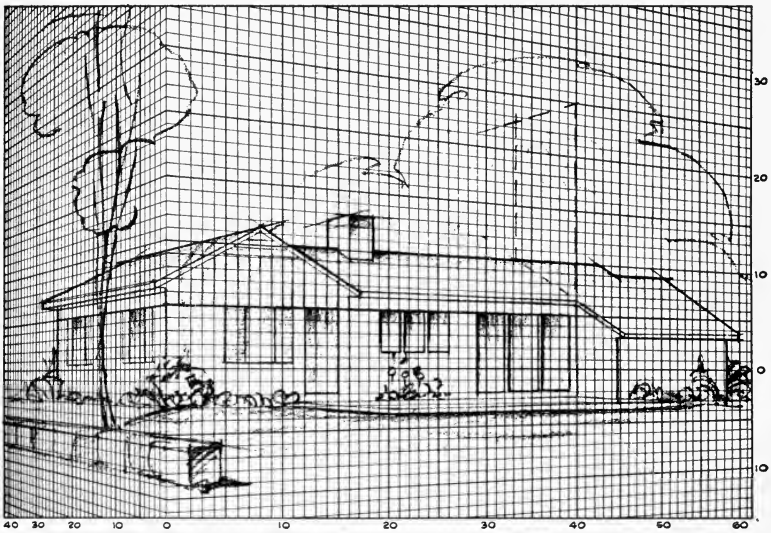


Figure 15. Outline of house laid out on perspective grid to give picture effect. This method eliminates technical problems of perspective drawing.

The U. S. Department of Agriculture, Washington, D. C., is a principal Federal source of bulletins on many subjects relating to housing, materials, equipment, and furnishings. Farmer's bulletins apply particularly to farm problems but contain much general information. Single copies of most bulletins are free.

The Superintendent of Documents, Government Printing Office, Washington 25, D. C., supplies publications from Federal bureaus at the cost of printing. Agencies concerned with housing subjects include the Forest Products Laboratory, the Bureau of Standards, Farmer's Home Administration, and the Housing

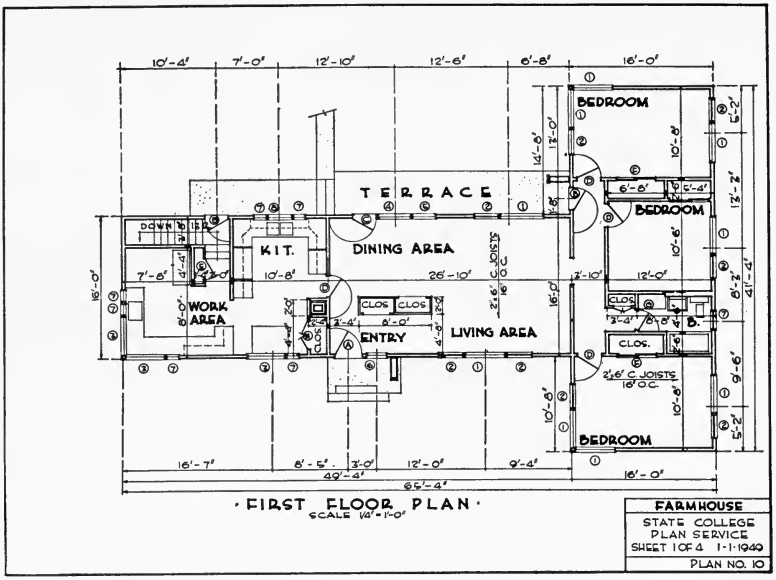


Figure 16. Typical working drawing showing floor plan. This is the University of Illinois "basic" farmhouse. The reduced scale of this illustration made it necessary to omit some dimensions and notations.

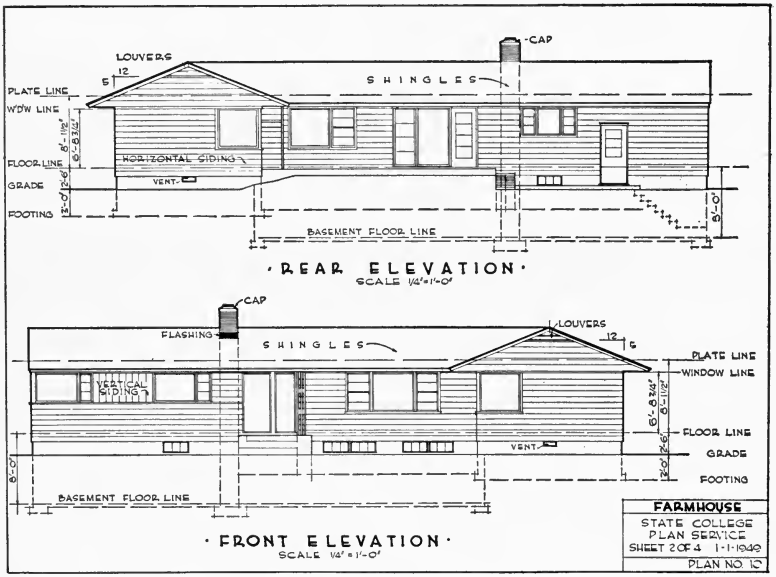


Figure 17. Another sheet of the working drawings of basic farmhouse. See Figure 101 for perspective and Figure 102 for simplified drawing.

and Home Finance Agency of the Public Housing Administration.

PLANS, MODELS, AND OTHER AIDS

Scaled drawings are necessary both for planning and as a guide to construction. Pictorial drawings help to visualize the house or its various parts. Models afford still more realistic visual aid. Photographs, motion pictures, and projection slides are valuable in the study of housing problems. Cutouts and special building blocks are available and are used frequently as an aid in planning.

House plans. The most common visual aid is the house plan itself. A set of plans, usually called the working drawings, is made to scale, with enough views, dimensions, notes, and details to afford a clear understanding of the entire house. Usually a set of working drawings includes a plan of each floor or level, exterior elevations with views of at least one side and one end, one or more cross-sectional or construction views, and details of stairs, cabinets, porch construction, or other parts that need explanation. The most complete sets also include a ground or plot layout, foundation and roof plans, four elevation views, details of cornice, doors, windows, moldings, and perhaps interior elevations of the walls of one or more rooms.

Blueprints. The blueprint is a reproduction made from the original drawings. As ordinarily made, it has a blue background and white lines. Originals are made on semitransparent paper or treated cloth. Plans may be printed by methods other than blueprinting, to give dark lines on a white background. Blueprints cost only a few cents per square foot. Copies of standard or "stock" plans may sell for less than $1, and up to $10 or more, although the originals may represent an investment of hundreds of dollars.

Pictorial drawings. Pictorial illustrations are essential to a study of housing. They are used extensively in this book to clarify statements and make the written material more understandable. Commonly used pictorial drawings include: *perspectives*, that show houses, rooms, or parts in the same way that they would appear in photographs or be seen by an observer; *isometric* or variations of it showing three dimensions of an object in a single drawing; and *plane*, or *orthographic projections* made in two

dimensions only, which show measurements, dimensions, locations, and other details of plan and construction.

Ordinarily the time available for a study of housing is not sufficient to acquire drafting skill. It is not difficult, however, to become proficient in sketching, laying out plans to scale, and understanding plans prepared by others.

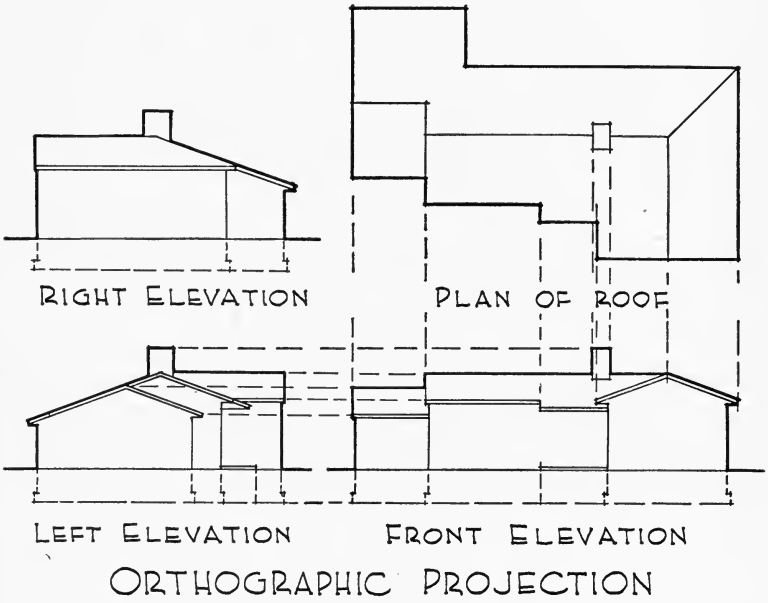


Figure 18. Plane or orthographic projection shows two dimensions in each view, and in true scale.

Models and other planning aids. Three-dimensional models are especially helpful in visualizing size, shape, and form. Wooden models are widely used by manufacturers for sales promotion and by teachers for exhibits and demonstrations. Their use is limited because of cost, but cardboard models can be produced economically and in large numbers. They show houses, kitchen cabinets, farmstead buildings, and other items. Cardboard models are printed in color, die-cut, and creased ready to fold into the proper shapes. These models are available from certain manufacturers, colleges, and supply houses. A few standard block sets are on the market which can be used to make up various combinations, sizes, and shapes of houses. Special models are some-

times made-to-order by architects and designers, but the cost is much higher than for standard models.

Cutouts, made to scale, provide a useful low-cost planning aid. Cutouts may consist of small-scale outlines of entire buildings

Figure 19. Folded 3-dimension model of a house. *Center:* flat sheet, cut and creased; *rear:* partly folded; *front:* the finished model.

to be used for a study of landscape planning and building location. House planning cutouts include pieces made to represent rooms, walls, openings, fixtures, fireplaces, cabinets, closets, and furnishings. Homemade cutouts can be prepared by drawing outlines to scale on cardboard or heavy paper, and cutting out the pieces.

Another useful aid shown in Figure 22 is a kit made up of several typical plans of rooms, porches, closets, stairs, halls, and so on, with different typical sizes of rooms and spaces. Many combinations can be used to make house plan arrangements for study and comparison.

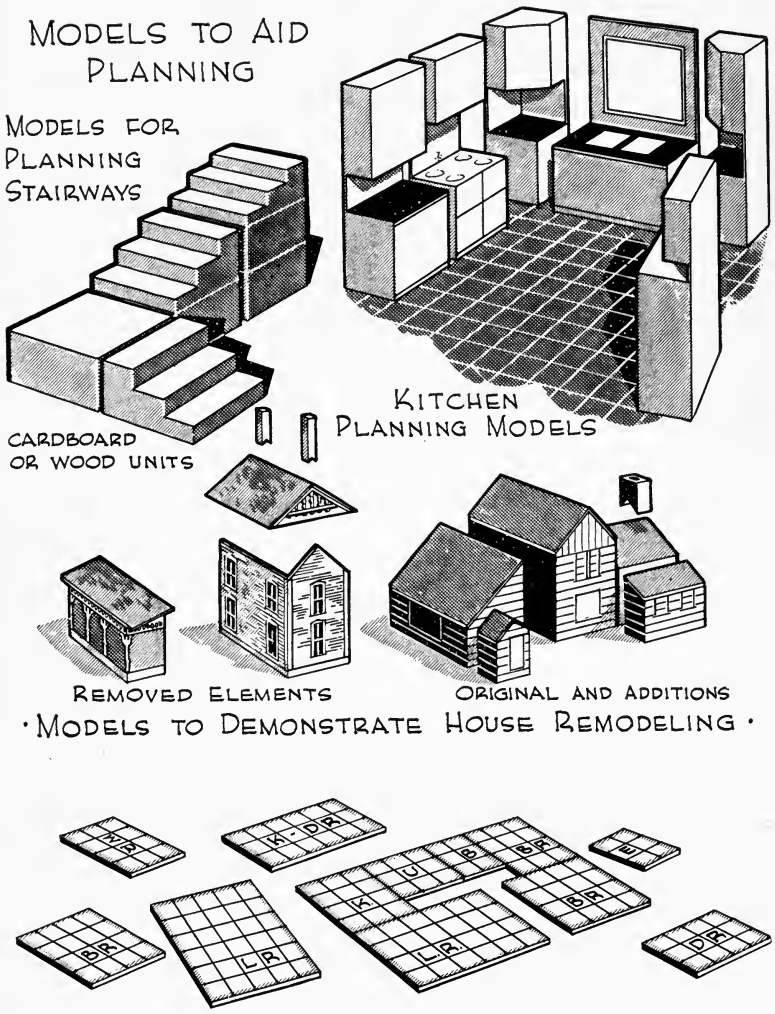
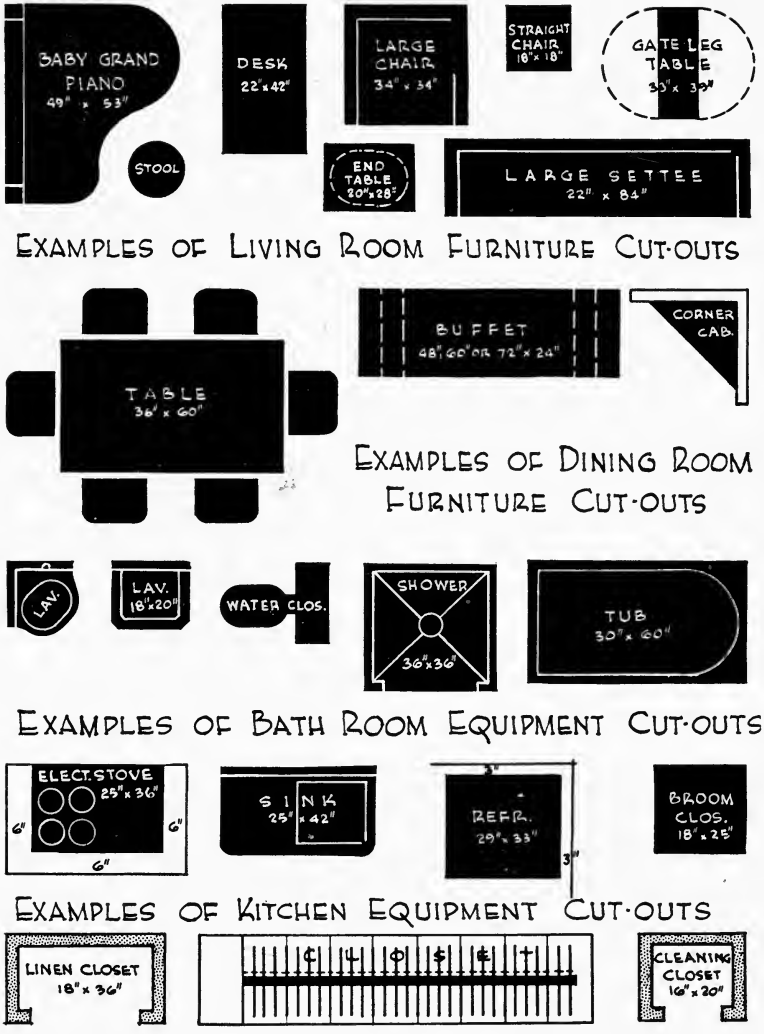

MODELS TO AID PLANNING
MODELS FOR PLANNING STAIRWAYS
CARDBOARD OR WOOD UNITS
KITCHEN PLANNING MODELS
REMOVED ELEMENTS
ORIGINAL AND ADDITIONS
· MODELS TO DEMONSTRATE HOUSE REMODELING ·
· PLANNING WITH ROOM OR AREA CUT-OUTS ·
Devised by Keith Hinchcliff

Figure 20. These models are used for classroom teaching and demonstration. See Figures 90 and 91 for other views of house models.

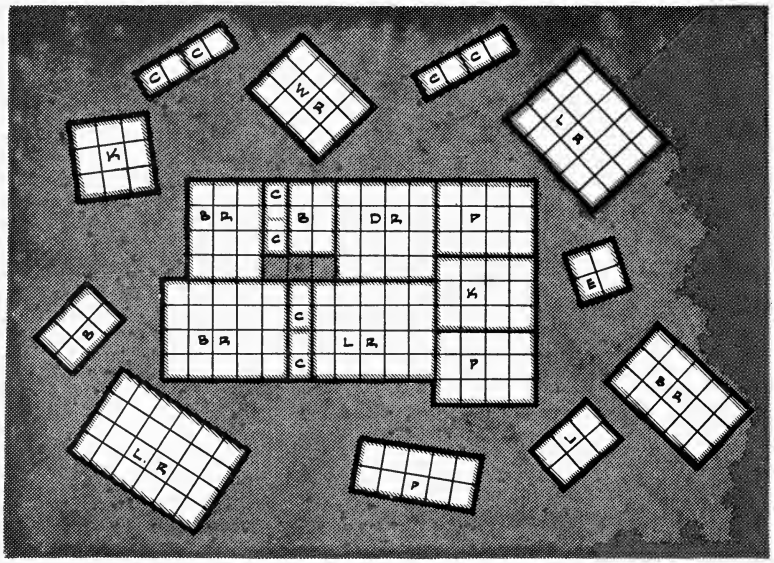


Adapted from Misc. Pub. 622, U.S. Dept. of Agriculture

Figure 21. Cutouts made to the same scale as the floor plan are useful aids to help in planning.

DELINEATION

Drawing is the means of visual expression so necessary to convey ideas of house plan, arrangement, and construction. It requires a vocabulary of lines, symbols, and notations. Scale is important to show objects in proper proportions. Liberal use of dimensions to denote distances, sizes, and measurements adds to the value of a drawing.



Blueprint from Univ. of Illinois. Sold at printing cost 15¢

Figure 22. Modular room and space cutouts for planning.

Freehand sketches should be used for preliminary study and for comparing arrangements and methods before making more exact or finished drawings. Sheets of cross-ruled paper having 4 or 8 lines to the inch are most convenient for problem study and elementary planning. Tracing paper may be used together with a ruled guide sheet placed under the paper.

Tools. Only a few tools are needed: no. H or 2H drawing pencils; a Celluloid or plastic triangle (either 45° or 60°–30°, 6- to 10-inch size); a T square; and an architect's scale rule. A pencil compass is convenient for drawing arcs and circles.

Lines. Plans contain a variety of lines of different intensities.

Generally main outlines are relatively heavy and firm. Secondary lines, which indicate background features, dimension lines, or minor detail, are made lighter in weight. Dotted lines denote objects not visible from the reader's viewpoint. Shading is often done with fine lines, either formally or freehand.

Symbols. It is necessary to use a simple understandable method of indicating parts of a plan and to distinguish among different

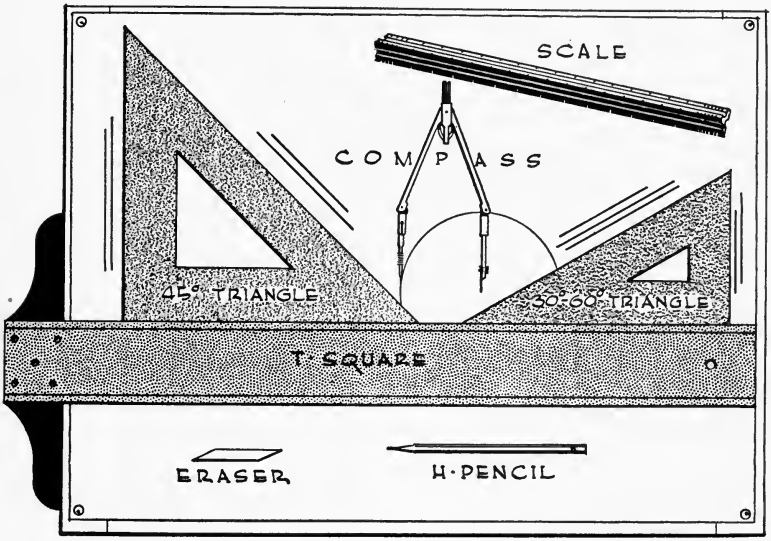


Figure 23. Only a few inexpensive tools are needed for house-planning study.

materials or the positions of pieces or parts. For this reason symbols are used to represent various objects or features. For example, a door in plan is indicated as an opening in a wall, with a line showing how the door will swing. Sometimes an arc is drawn to show the space that must be kept clear for the door. In a similar way, a window is symbolized by lines to show width and type. The illustrations show common symbols used in house plans.

Scales. A uniform reduction from full size is necessary to keep all parts of a plan in proportion. House plans are usually made to a scale of one inch to 4 feet, and so ¼-inch on the drawing is equal to 1 foot actual size. This is usually indicated as ¼″ = 1′–0″. Other scales often used are ⅛″ = 1′—0″ for larger objects and ½″ = 1′–0″ for small houses or for room plans. Details might be

1″ = 1′–0″ or even larger, up to actual size. Plans are most convenient to read if made to common fractional scales of ½, ¼ or ⅛ inch equal to one foot. Then ordinary tapes, rulers, and steel squares having divisions in fractions of an inch can be used to

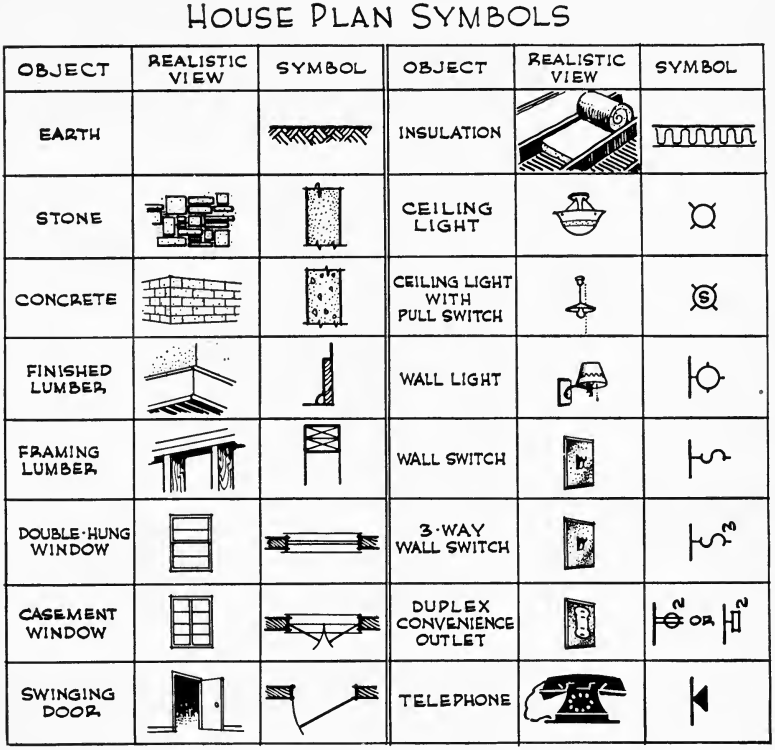


Figure 24. Common symbols used in making plans.

measure distances. For laying out plans draftsmen use an architect's rule on which the fractional parts are marked in feet and inches.

Dimensions. Although drawings may be made to scale, the scale alone cannot be used on small-sized plans to determine details of construction or the position of important parts. Scaling does not provide a quick answer to questions that come to mind in viewing a plan; therefore, dimensions are a necessary part of a drawing.

The principal dimensions on a house plan include: (1) over-all, or outside measurements, (2) center position of openings in walls, unless the position is obvious or unimportant; (3) measurements from outside edges of exterior walls to center of each partition or division, to indicate locations; (4) approximate net inside width and length of each room or space; (5) size of objects, such as sink,

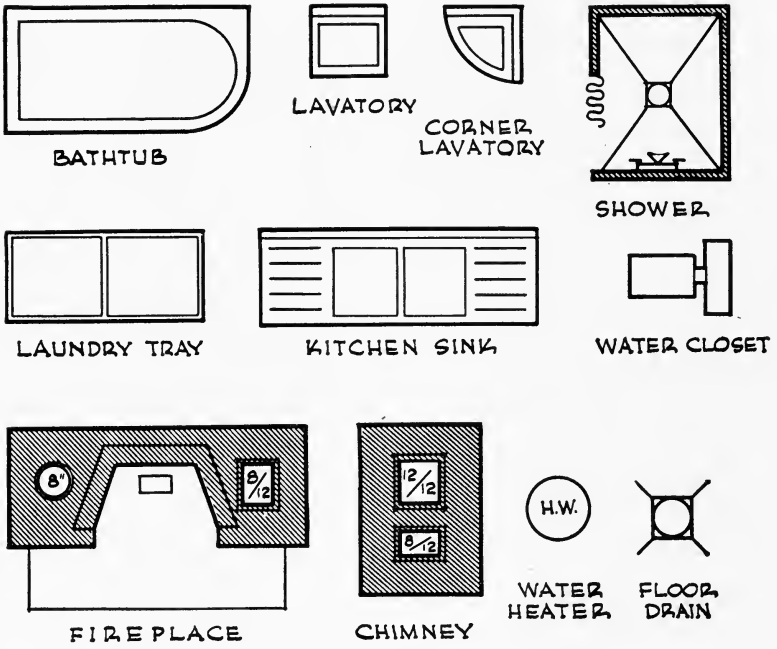


Figure 25. Symbols used to show objects on plans.

bathtub, fireplace, or small parts; and (6) notations of size, spacing, or measurements of material sizes, ceiling heights, and other details.

Three kinds of dimensions are found on typical house plans: *linear measurements* marked on dimension lines, exact distances being denoted by spear points and limiting lines; *widths and lengths* shown on the room or space; and *sizes* of objects. Small sizes may be stated in inches only. Large objects, exceeding 2½ or 3 feet are noted in feet and inches. Even though a measurement may be an *even number* of feet, it is well to indicate *zero inches*

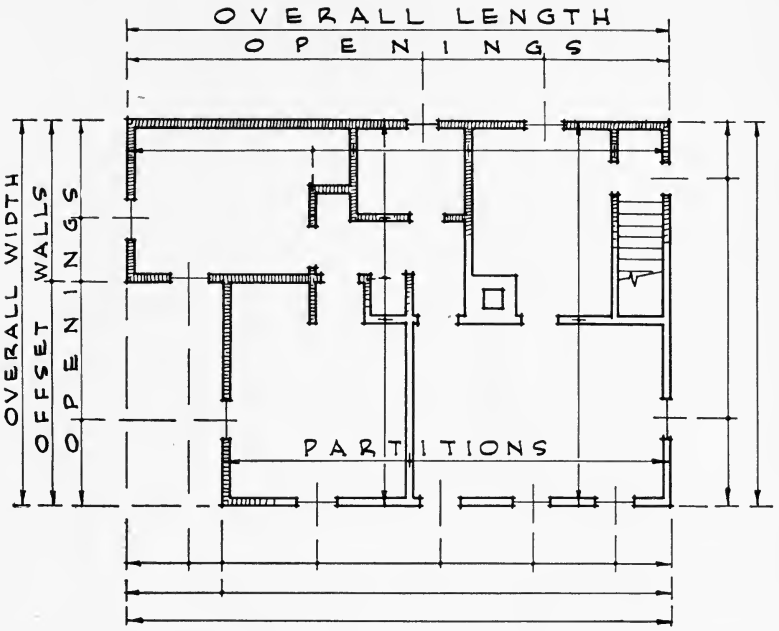


Figure 26. Dimensions needed on scaled drawings to enable builder to lay out the house.

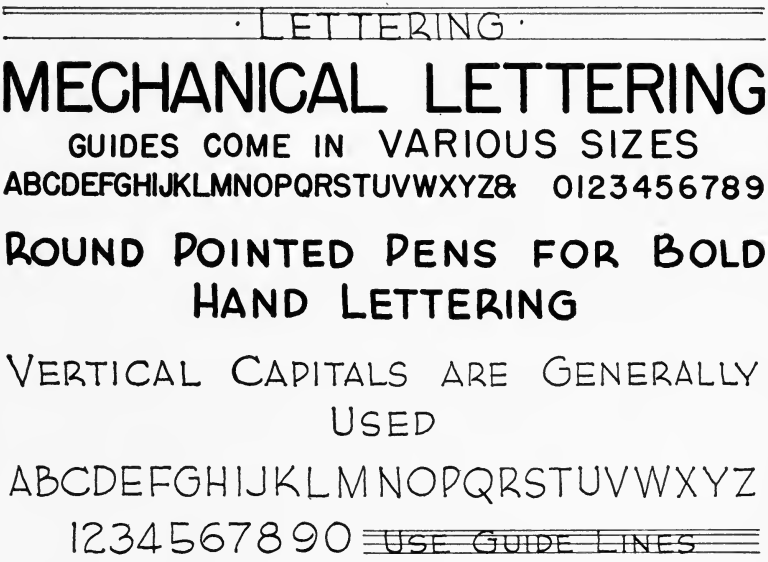


Figure 27. Examples of lettering. Also note lettering on drawings throughout this book.

to satisfy the reader that the inch measurement was not overlooked. LETTERING. Drawings need liberal notes to explain details that might otherwise be obscure. Even on simple sketches the principal parts should be named. Neat readable lettering and clear figures add greatly to the appearance and usefulness of a drawing. In making letters, a plain readable style should be adopted. Pencil guide lines should be drawn to aid in making uniform notations. Mechanical lettering guides are often used in commercial work.

CHAPTER 4

Approach to House Planning

Houses should be planned to provide space and an arrangement of space and equipment that best serves the functions of housekeeping, homemaking, and family living. "Functional planning" means planning to accommodate people and their activities within the home.

The key requirements are quite simple. Each room should be planned according to its intended use, with enough space for effective arrangement of furnishings and equipment, and for normal activities or occupations of family members. Each house should be planned so that rooms or areas are put together in a convenient space-saving arrangement.

Many modifications may be made to fit plans to a given set of conditions, to face the house properly to the street, or to take advantage of winter sunshine or summer breeze. Endless combinations might be made of number of rooms, size of rooms, one-story and two-story plans, compact and rambling styles, elaborate and simple accessories, and other details to satisfy personal preferences.

Regardless of the modifications, however, the first approach in planning is to find the elements that are fundamental in all houses. The *similar* characteristics of houses are far more important than the *differences* that distinguish one from another. Once the basic principles are found, the functional plan can then be adapted or modified to meet a specific situation.

The basic requirements must be met in the general plan by the provision of "areas" for each primary purpose. These are defined as follows:

Recreation. This includes the parts of the house used for family living, group activities, reading, studying, visiting,

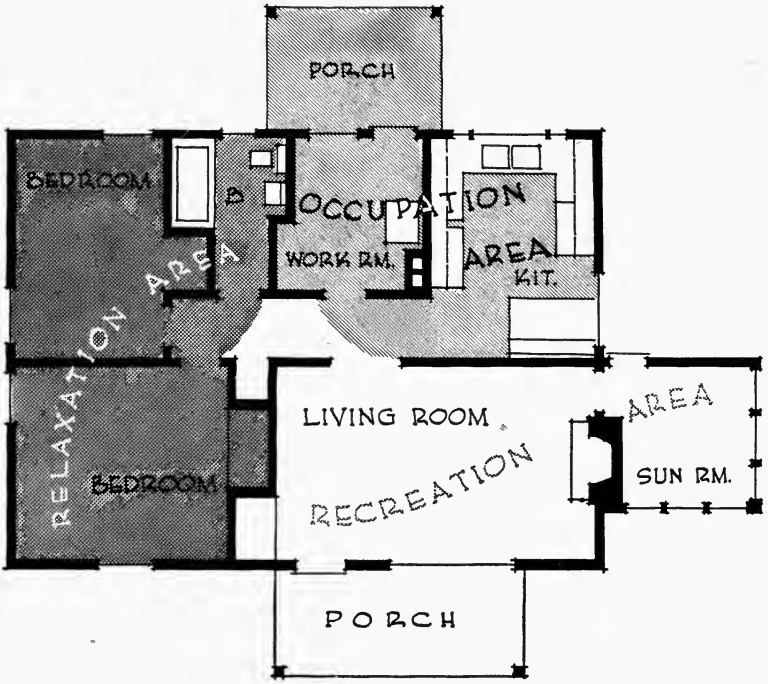


Figure 28. Basic plan for family living requires three zones, or primary areas, of activity.

listening to the radio, and dining. This area might be considered as the public portion of the house. In addition to the living room, the space includes entrance hall, wrap closet, sunroom, and dining room. Sometimes the plan may have a separate recreation room, a "family room," or a study.

Relaxation. This area is the private part of the house, or the "quiet zone." It has bedrooms, bathroom, and closets for personal possessions. It is planned for convenient passage from bedrooms to bath. In most single-family houses the "part for sleep and rest" is planned as a single unit. If other bedrooms are located on a different floor, or in a wing they also should meet the requirements of privacy, quiet, and convenience.

Occupation. This is the work area of the house, where the housewife spends the major part of her working time. Re-

quirements include kitchen, workroom, laundry, space for eating family meals, and room for equipment, utensils, and supplies.

It is apparent that boundaries cannot be set to confine the activities of recreation, relaxation, and occupation within definite parts of the house. Bedrooms may contain lounge chairs, radio, and study table; sewing, mending, ironing, and other duties may be done in any one of several places; and relaxation is not limited to a particular part of the house.

Nevertheless, the house plan may be visualized as embodying these three principal areas, each of which is a unit of plan that cannot be omitted. The interrelation is so important, however, that the value of a house plan depends on putting the areas together in a workable arrangement.

PLAN PATTERNS

The grouping of the area "units" produces a plan "pattern." All well-planned houses are based on the general pattern of: (1) a living room (recreation area) and its related spaces, (2) a private unit for sleep, rest, and quiet (relaxation), conveniently reached from the living rooms or hallway but not through the kitchen, and (3) kitchen and other work space (occupation area) readily accessible from the living rooms.

The pattern scheme can be illustrated by visualizing a number of circles, partially overlapping, to represent the spaces for recreation, relaxation, and occupation and related areas or surroundings. Just as the circles may be placed in various positions and yet remain linked, so the parts of the house can be grouped in various ways; be connected by doorways, halls or stairs; and be related to outdoor areas.

Typical house plans are usually based on variations of a common pattern. Without regard to details, each plan may be considered as consisting of three primary units: (1) living rooms, (2) bedrooms, and (3) kitchen and work space. If the living room unit is made the center of an H shape, with work rooms on one side and bedrooms on the other, the result is the popular H pattern. Placing kitchen and living room units in a line with the bedrooms at right angles produces a T-shaped, or an L-shaped plan. The simplest "shotgun" house, consisting of 3 rooms in a straight line

can be made into a functional pattern by a few modifications. Likewise, the old-style square 4-room cottage requires only

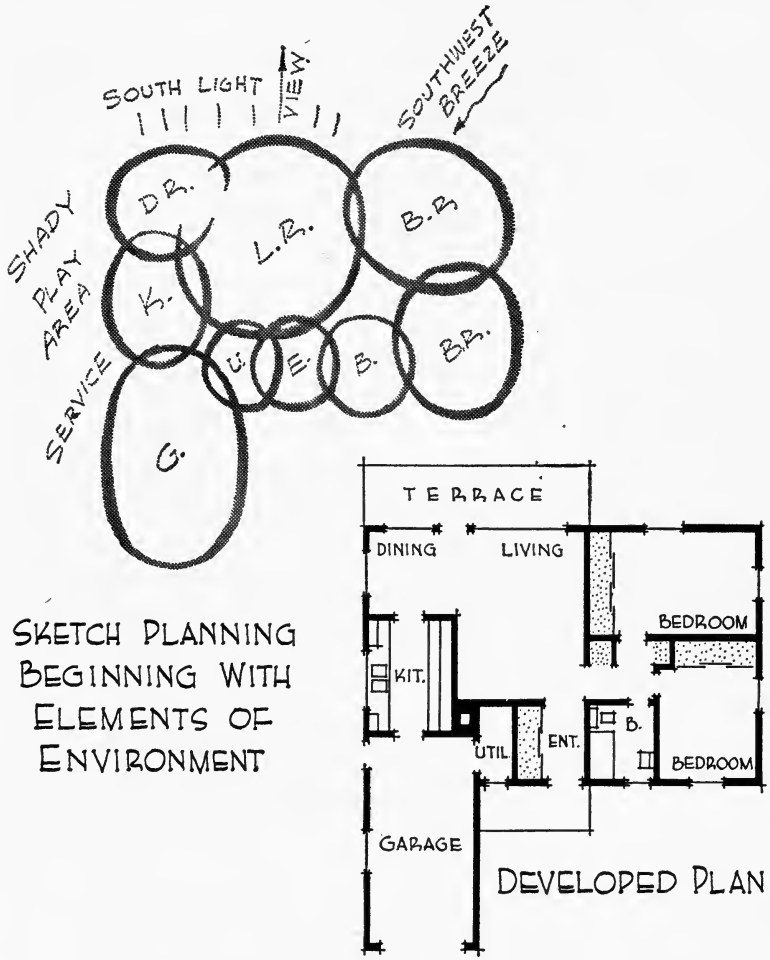


Figure 29. Pattern planning takes account of interrelation of interior function and outside factors.

slight rearrangement to become the basic pattern of many small one-story houses. In houses having more than one story, the pattern is retained, since the stairway forms the connection between the living and sleeping areas.

Trends in planning do not destroy the value of the pattern approach. For example, a very small house must combine more than one function in one room, as kitchen–dining–workroom and living–sleeping combinations. The "open" plan may have the

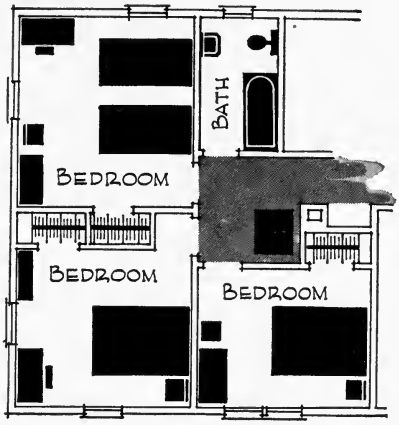


Figure 30. Typical pattern for relaxation area consisting of 3 bedrooms and bath. Cutouts are used in planning the arrangement.

dining room as an alcove off the living room, the kitchen and workroom separated only by a work counter, and principal rooms and entrance hall connected by wide openings without doors. Yet the plan itself need not lose the characteristics of the basic pattern.

ADAPTING BASIC PLANS

The pattern approach is valuable because it assures a functional plan and a grouping of activities in a way that meets typical family needs. Pattern planning would be worth little, however, unless it permitted a "space design" that could be fitted to different locations, changed in size and proportion, and varied in style. Following are the principal ways to fit the general plan to specific situations:

Reverse the plan. Turn the plan over and view it from the back by holding it in front of a light. Reverse either by turning the plan from right to left or from bottom to top to obtain the arrangement best fitted to a given location.

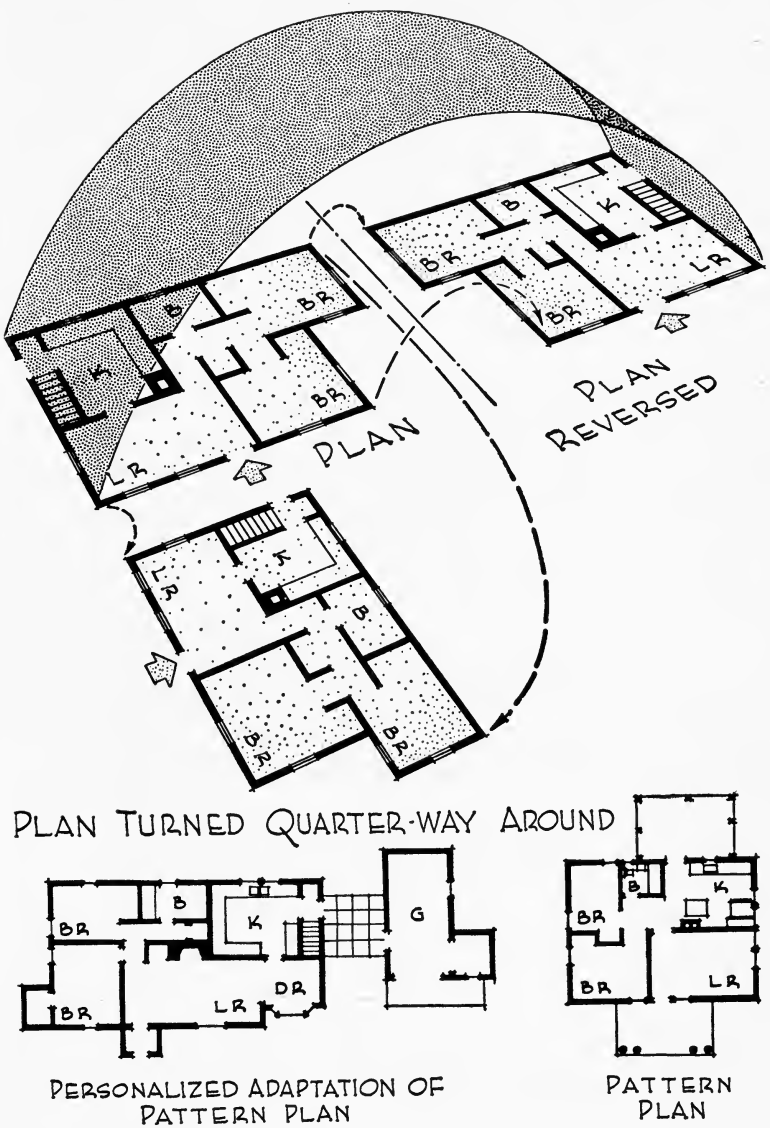


Figure 31. Basic patterns can be adapted, changed, or personalized to meet specific needs.

Turn the plan around. Turn the plan quarterway around in either direction or halfway, if necessary, to fit it to face north, east, south or west, as desired.

Change room sizes. Sizes can be increased or decreased for the entire house or room by room without disturbing the basic pattern.

Shift position of units. The units of the plan can be arranged in different ways to place certain rooms to the rear, at one side, or in front, as desired.

Select any style. The style of the house has no bearing on the plan pattern, and so any suitable combination of roof slopes, colors, materials, eave projections, and types of windows may be used.

COMMON ERRORS OF PLANNING

The details of space planning and room requirements are discussed in succeeding chapters. The pattern itself establishes only the general arrangement to meet living needs and avoid deficiencies due to careless planning. Planning is a positive approach to solving problems, and the following "negatives" are listed only because they are examples of common errors found in many plans:

1. Don't have entrance to bathroom through a bedroom or kitchen.
2. Don't have more than one door to bathroom.
3. Don't separate bedrooms by living room, dining room, or kitchen.
4. Don't use bedrooms and kitchen as main trafficways; avoid traffic through the living room as far as possible.
5. Don't separate storage space for articles from the place where the stored articles will be used.
6. Don't break the work centers in the kitchen by doors or passageways.

PERSONALIZING PLANS

The pattern approach to house planning is impersonal and is useful for outlining universal requirements of space arrangement and relationship. Selecting a general pattern and adapting it to the site, type, and style of house is the most important step. The

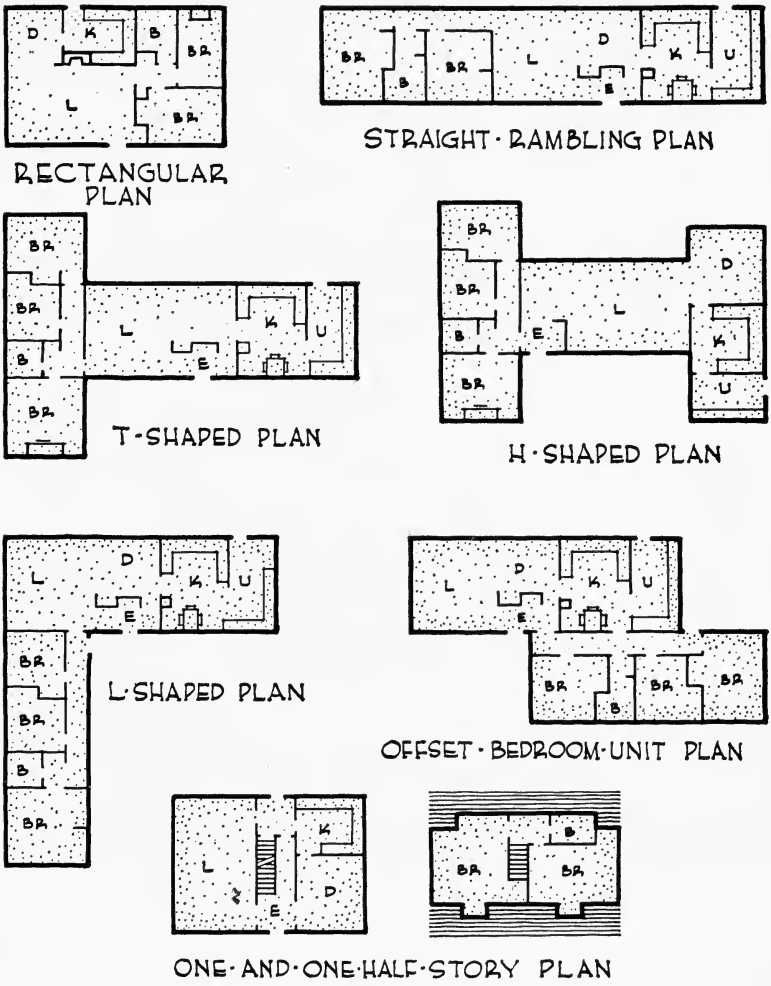


Figure 32. Plan requirements can be met in a wide variety of patterns.

pattern is essentially the "standard" which can be changed at will in the details that make it one's own personal plan. The individual who is fortunate enough to have the service of a competent architect can be assured that his plan will be personalized in a consistent manner. The architect works from a "program"

or a list of conditions, preferences, and requirements to fit the particular case. He is trained to develop special plans by adapting basic patterns to the family's program.

Conflicts are sure to arise between personal preferences and what can be attained in a practical manner. In each case the conflict should be resolved by comparing costs and relative advantages and disadvantages. The solution is then a process of making alternate choices. For example, one may object to the "rambling"

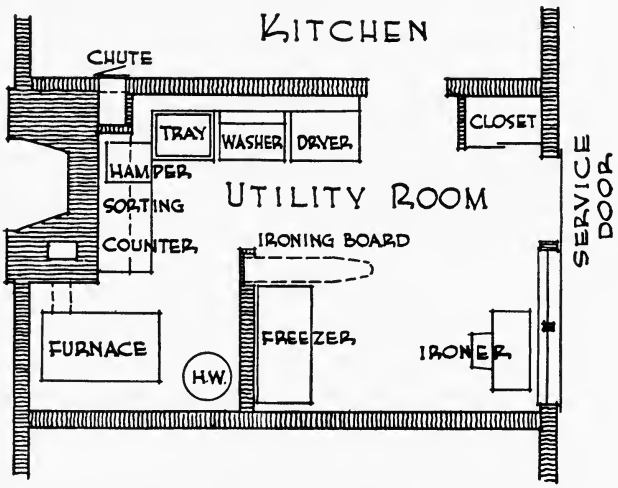


Figure 33. First-floor utility room. An example of planning to meet functional needs.

character of a 6-room house on one floor or to the distance between the kitchen and the bedrooms. The alternative, however, may be a two-story house in which stair climbing is involved for each trip from the living rooms to the bedrooms and bath.

Objection may be raised to a plan in which the living room is the "trafficway" between work areas and bedrooms. To some, this does not seem objectionable; to devise a different plan might mean added cost. Preferences vary in the choice of a place for serving meals, or of a house with or without a basement. Experience, custom, habit, and personality influence each person's attitude toward a given plan. Whatever the personal preference may be, however, the plan should not vary from the typical basic patterns in important relationships of space.

Normally, it is not essential to have individually designed houses in order to achieve personal satisfaction. Changes can be made in features such as windows, doors, trim, cabinets, fireplace, and stairs, and selections may be made from a wide variety of designs. Personal taste can be expressed in the choice of colors, finishes, furniture, rugs, draperies, and other accessories without changing the basic nature of the plan. Different exterior surfaces, roof shapes, and colors give individuality in a community of houses.

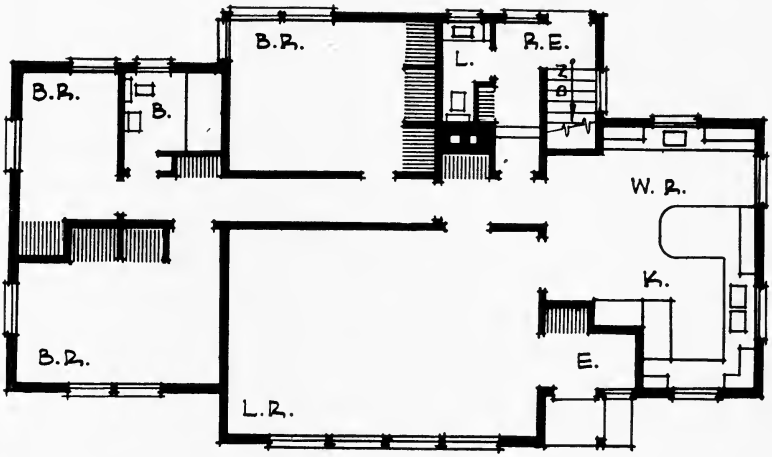


Figure 34. Pattern plan for one-story house. Well designed areas of activity, convenience and ample accommodation.

JUDGING PLANS

In judging a plan, the problem is to compare relative values and to distinguish between vital and unimportant features. Plans often show tiled baths, tinted plaster, cedar-lined closets, elaborate fireplaces, and other features having "eye appeal" to attract attention. However desirable these may be, they should be compared with well-designed but less expensive features, or with other additions which might be more useful. The whole house should be consistently good in plan, structure, and equipment if it is to provide the best and most economical housing.

The number of rooms is not a satisfactory measure of the size or adequacy of a house. Utilities, closets, cabinets, finishes, and the way the space is utilized may be more important than the

number of rooms. A good house plan, based on a "pattern" arrangement, will be suitable for many different families, for it can be adapted in details to meet individual needs. Many plans are rejected only because minor features do not appeal to the prospective owner; often such features could readily be changed to make the plan more acceptable.

It is only by comparing plans point by point that basic values can be brought out. Is the appeal due to a gadget or an eye-catching device or to good arrangement, sturdy parts, and durable materials? Are objections to a plan based on its failure to meet needs, or on a detail of style, equipment, or materials? Careful comparisons may reveal important differences in plans that at first appear to be much alike. The various details often mean the differences between a good plan and a poor one, as, for example, the size and shape of rooms, amount of closet storage, spacing of doors and windows, safety features, and provision of space for furniture and equipment.

Houses attractively pictured in a book, bulletin, or magazine may look entirely different when built on a narrow lot, or close to other houses of a different style. Builders sometimes change a plan in order to use other materials than shown in the plan; add or remove porches, eaves, or shutters; or use a different siding. Sometimes roof pitches, foundation heights, and window types are modified from the original design. Changes may be necessary to fit a "stock" plan to a given location, but unless alterations are made by an experienced designer the results may be disappointing.

Plans are judged by: (1) comparison with general principles and basic needs, (2) their adaptability to many different situations, and (3) how well they conform to ideals and goals. The following questions apply directly to the suitability of the house plan:

Can the house be fitted to the site? The house must fit the lot and conform to the local code requirements. Is there convenient access to the garage and the house entrances? Does the facing on the street put living rooms and bedrooms in the desired position? Can the plan be fitted to the site if it is reversed, or given a quarter or half-turn?

Are the rooms the right size? Compare the plan with other plans to determine the relative size of rooms. Can one or more room sizes be changed without spoiling the plan? Does the

plan have unusually small rooms in order to show more rooms in a small total space?

How is the space divided? Has convenience been sacrificed in kitchen or bedrooms in order to have a large living room, a separate dining room, or a formal entrance hall? Is the space fully utilized? Is space wasted in hallways or other parts?

Is the plan convenient? Check the plan for the number and size of closets, direct passage from one part to another, protected entrances, safe accessible stairway, usable basement space, and adequate kitchen and workroom arrangement.

Can each room be furnished properly? Is there enough wall space for beds, sofas, and other furniture? Do doorways interfere with good arrangement? Is the size and shape of each room suitable for typical needs?

Is the plan flexible? Can some of the rooms be adapted to meet varying needs of different families? Is there space for reading, study, and entertainment? Can one or more rooms be used for emergency sleeping space, children's play, and sewing?

Is the plan too elaborate? Does the plan include fireplace, extra bathroom, enclosed porches, large hallways, finished attic, recreation room, and other features, which although desirable may increase the cost too much?

Is the plan complete? Does the plan show flues, lighting and wiring arrangement, kitchen equipment and cabinets, and attic stairs? Sometimes a plan is unsatisfactory because provision is not made for the necessary heating, plumbing, and other equipment.

Is the plan and style suited to the location? Be sure the house will fit harmoniously into the general character, type, and value of houses in the community.

ANALYZING PLANS

One of the best ways to analyze plans and to judge their value is to examine them for their basic pattern arrangement. The following is suggested as an interesting study:

Obtain a plan book of small houses, several plans from popular magazines or trade journals, or blueprints of a number

of house plans. Classify the plans as to 1, 1½, and 2-story houses. Study the general arrangements. How many different patterns are represented in the total? Are several of the plans essentially alike except for some minor difference in room size, position of entrances, or other details? Do any of the plans depart radically from the basic pattern of room relationships? Sketch the most common arrangement found in one- and two-story houses. How did the designer or author make various houses appear distinctive or individual, even when the floor plans were similar?

CHAPTER 5

Kitchen and Workroom

The "occupation area" was outlined only as a unit in the basic plan pattern. Now, precise planning is needed to obtain the best and most convenient arrangement of space and equipment. The kitchen and workroom are the principal parts of the work area, which—together with related storage spaces, traffic lines, and entrances—make up the "service" portion of the house.

The planning of this important area has often been neglected. The size and shape are largely "accidental"—the leftover space after living and sleeping rooms have been provided. Some kitchens are only 6 or 8 feet square, others range up to 16 feet each way, with all possible combinations of width and length. Unless the house has a finished basement, little or no space may be available for washing clothes, canning, or storing large quantities of food. Even in new houses, kitchen and utility space is often too small to accommodate modern equipment and afford an effective arrangement.

Two concepts of "kitchens" must be considered in planning. Traditionally the kitchen is a room, primarily for preparing food and doing the related work of serving and clearing away. It must often provide also for other activities, such as caring for children, serving meals, ironing, resting, and visiting. Recently the term "kitchen" has also come to mean just the array of cabinets and appliances for work with food. Manufacturers have their particular brands of "kitchens" consisting of cabinets, counters, and appliances. Many small kitchens are just large enough to accommodate the cabinets and equipment.

These concepts of the kitchen, both as a room and as an assembly of equipment, are necessary in planning. In effect, the kitchen as a facility for foods work becomes a part of the whole kitchen

unit. The smaller the room, the more of it will be occupied by equipment; the larger the room, the more completely it will serve the various uses for which it can be fitted.

Thus, no definite size and shape can arbitrarily be considered as the best. Rather, the plan should be derived by following a basic

Douglas Fir Plywood Association

Figure 35. U-shaped arrangement of sink and cabinets; adjacent workroom and laundry.

planning method which will result in a practical workable arrangement. It is most satisfactory to plan from the "inside out," letting requirements, space needs, and furnishings determine both size and arrangement. Then the plan becomes an organized unit, convenient to work in, and free from errors of inefficient use of space or poor location of doors, windows, and passageways. The steps involved are: (1) planning the equipment, (2) fitting the arrangement into a suitable type, (3) establishing measurements, (4) selecting equipment, (5) deciding on room arrangement, and

Lustron Corp.

Figure 36. Compact arrangement of commercial units along one wall in prefabricated house.

(6) modifying the kitchen to fit the house. Much the same procedure is followed in planning workrooms and utility rooms.

PLANNING THE EQUIPMENT

The work of preparing food, clearing away after meals, and storing utensils and supplies requires "centers" of activity. Generally, these centers are identified with major items of sink cabi-

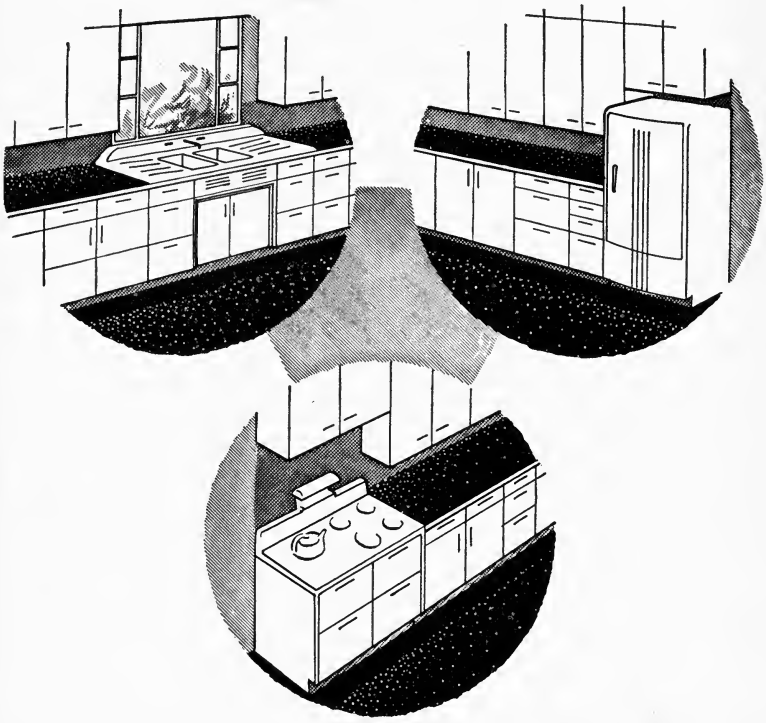


Figure 37. Kitchen work is largely centered at the sink, refrigerator and range, and adjacent cabinets.

net, cooking range, and refrigerator. In reality, the kitchen equipment makes up a single work center, for the work requires frequent movement from one piece of equipment to another. Work surfaces are necessary, and storage space must be provided for food supplies, dishes, tools, and utensils. Storage is needed near the place where the different items are to be used and within

easy reach. Besides the major equipment, space is needed for reserve supplies and kitchen appliances. A dishwasher, and a frozen food cabinet are sometimes included. In the complete plan, the kitchen equipment becomes a "production line" for

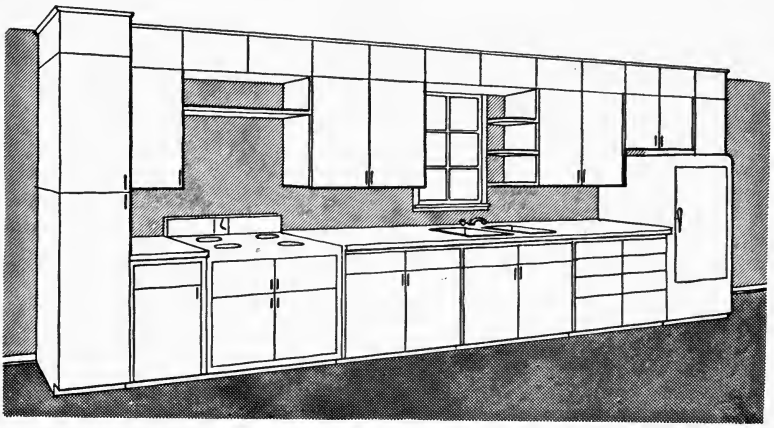


Figure 38. Kitchen units combined into a straight line.

all work necessary to prepare food for serving and to clear away after meals. The following outline gives the step-by-step procedure for planning:

Visualize the arrangement in a single straight line as if it were along one wall. Pay no attention to doors and windows or to the size and shape of the room.

Locate the sink at the approximate center of the unit because so much of the work of food preparation and dishwashing requires hot and cold water and drainage.

Place work counters at the right and left of the sink. At least 3 feet of work counter space is needed on each side for stacking dishes and doing other work that requires table space.

Locate wall cabinets to utilize all reachable wall space above work counters, except for windows and perhaps the wall above the range.

Place base cabinets below work counters. Cabinet sinks have built-in storage space. A dishwasher may replace one base

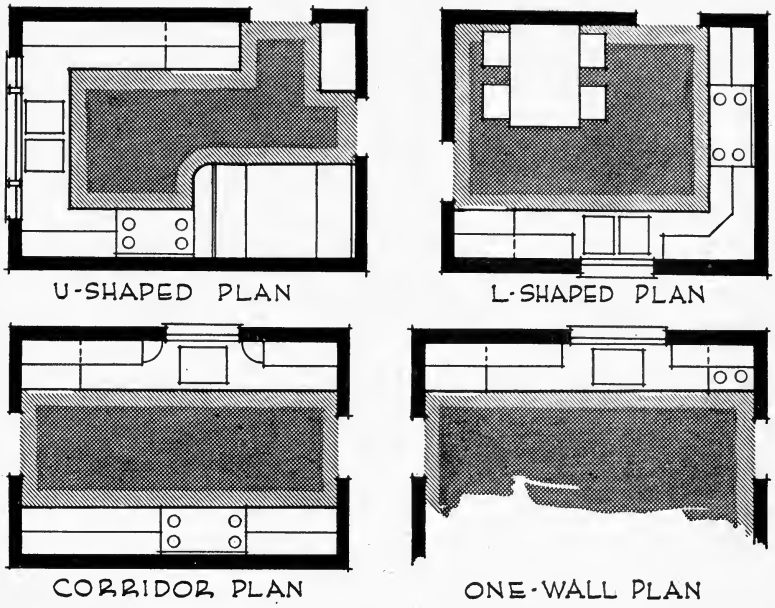


Figure 39. The straight-line assembly is arranged in different ways to make various "types" of kitchens.

cabinet. In compact plans, electric water heaters might be a part of the cabinet arrangement.

Plan refrigerator space in the line of cabinets, or at one end of the line. Be sure refrigerator door is hinged on the proper side, so the latch is on the side nearest the work counter.

Place the range at or near one end, usually at the end opposite the refrigerator. Counter space is needed at least on one side of the range. Some modification in plan must be made for a wood or coal range, because of heat, fire hazards, fuel storage, and chimney location.

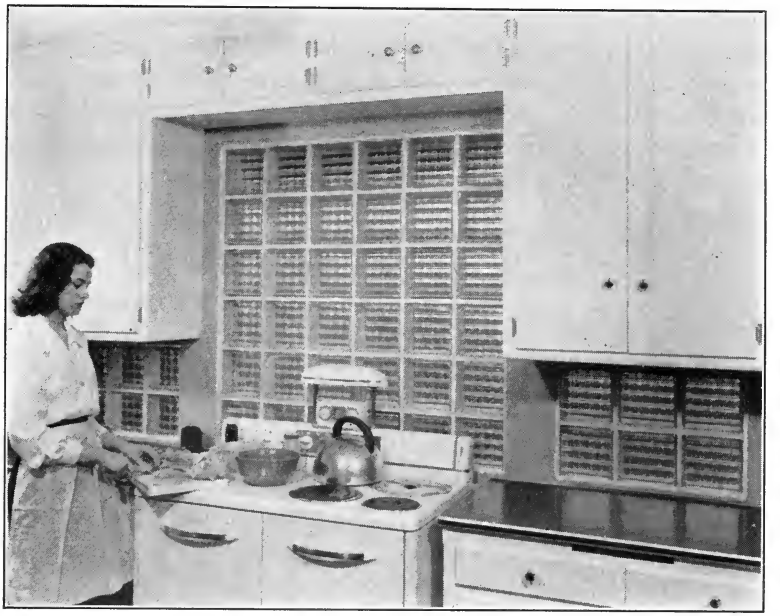
Include one or more utility cabinets, laundry machine, or supply storage cases as needed.

TYPES OF KITCHENS

The equipment plan resulting from the straight-line arrangement must now be fitted to the room. The way the line is placed along the walls determines the kitchen "type." In each case the

starting point is the sink, with its adjacent counters and cabinets. Following are the usual types that result from arranging equipment in different ways:

ONE-WALL KITCHEN. In very small houses or apartments, the facilities are sometimes placed along one wall or in an alcove which opens into the room. To do this, it is necessary to use



Owens-Illinois Glass Co.

Figure 40. Range center with adjacent work surface and cabinets. Note use of glass blocks.

small-sized equipment and restrict the storage space; this type would not be suitable for the larger items of equipment and for the amount of cabinet and counter space desirable in the adequate kitchen.

PARALLEL-WALL OR CORRIDOR KITCHEN. This type is used if the kitchen is very narrow, or too small to be used in other ways, or if the doors are in the end walls. Then the sink and adjacent cabinets are placed along one side, and the range and additional cabinets are located against the opposite wall. The refrigerator may be on either side, depending on available space. The room

should be 8 feet wide for two rows of equipment and enough space to work between them.

L-TYPE KITCHEN. In a relatively large room, it may be possible to space the line of equipment on two adjacent walls in an L shape. This leaves the remaining space free for doorways, traffic lines, and other uses.

U-TYPE KITCHEN. The U kitchen is arranged with the sink in the approximate center of one wall, and the range and refrigerator opposite each other on adjacent walls. This affords a continuous combination of appliances, cabinets, and work surfaces, unbroken by doorways or trafficways. The U kitchen generally fits best if the room is 8 to 10 feet wide; in wider rooms the equipment on opposite walls is too far apart for convenience.

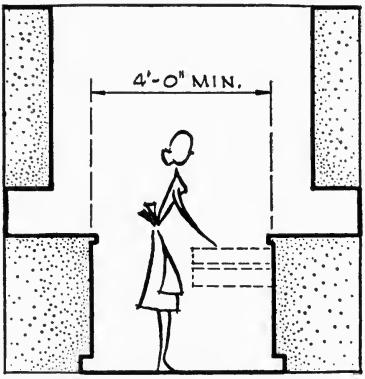


Figure 41. Allow 4 feet between equipment items on opposite walls for convenience.

KITCHEN MEASUREMENTS

The minimum kitchen size is determined by the space necessary to place the equipment along one or more walls. The maximum size depends on the elaborateness of equipment and the provision made for other activities in the room. Ranges, refrigerators, and cabinets project 24 to 30 inches from the wall. At least 3½ to 4 feet of clear floor space is needed in front of the sink, cabinets, and other equipment. Dinette, frozen food cabinet, and laundry equipment require additional space if they are to be included.

The following measurements are commonly used in planning the kitchen:

Depth measurements (front to back). Sink cabinets and work counters are 24 inches deep. Counter tops project slightly beyond the base cabinets which are approximately 23 inches front to back. Most cabinets are set on a recessed base about 4 inches high which provides "toe space." Wall cases are made in different depths, but 12 inches is the most common front-to-back dimension.

Linear measurements (widths). Most new sinks are an integral part of a sink cabinet, or they are flat-rim types that are set in a continuous counter top. Sink widths vary from about 20 inches for a small single sink to 48 inches for double-basin types, without the drainboard. The range requires a space of 42 to 48 inches. Household refrigerators of average size required up to 36 inches of wall space.

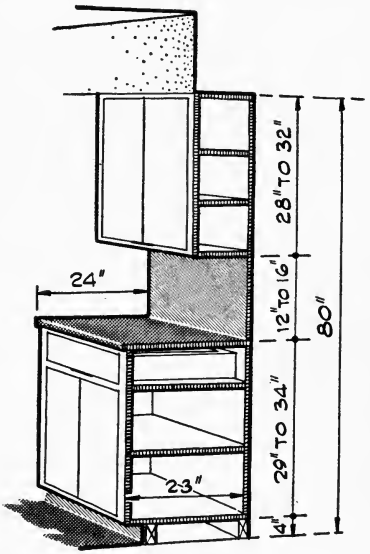


Figure 42. Typical height measurements.

Base and wall cabinets are manufactured in several standard widths, or they may be specially made to fit exactly into available space. Most single units are 20 to 24 inches wide; double units are 36 to 48 inches wide; other sizes and combinations are available. There is no general agreement as to the total length of counters and base cabinets needed; probably 6 to 8 linear feet would be regarded as a practical minimum.

Height measurements. Vertical dimensions of kitchen equipment are rather clearly prescribed by construction practice, manufacturer's standards, and the housewife's limit of height and reach. Special equipment might be made to satisfy the

owner's requirements, but the cost might be more than for standard sizes. Moreover, the next occupant of the house might prefer a different height of work surface or another arrangement of cabinets.

Recessed cabinet bases are normally 4 inches high, and base cabinets are 32 inches high, making a total of 36 inches to the counter top. Sink, base cabinets, dishwashers, and ranges usually are 36 inches high. A clear space of 12 to 16 inches is needed between work counters and wall cabinets above them, if full use is to be made of the counter. The highest shelf should be about 5′–8″ above the floor in order to be within reach. Therefore, the top level of the wall cases should be about 6′–8″ high. Tops of doors and windows are also 6′–8″ above the floor. Room heights are approximately 8 feet, measured from the finished floor to the ceiling. The space of approximately 16 inches between reachable wall cabinets and the ceiling may be permanently enclosed, or, it can be used to good advantage for high wall cabinets to store seldom-used articles and supplies.

The height of work surfaces is the most disputed measurement in kitchen design. The preferred height varies from about 31 to 33 inches for workers of less than average height, up to 37 or 38 inches for unusually tall persons. Various operations, such as cutting, mixing, beating, and kneading each require a different height for greatest convenience. The sink basin becomes a work level for some operations, particularly dishwashing. The sink rim must ordinarily be level with the countertop and the sink should be at least 6 inches deep, which makes some compromise necessary. Some individual adjustments or variations from the usual standard of 36 inches above the floor can be made for convenience by: (1) using base cabinets with one or more pullout boards 2 to 4 inches below the countertop, (2) having a higher or lower counter top on a section not along the same wall as the sink cabinet, and (3) providing a movable table for work requiring a low work surface.

MAKING THE KITCHEN PLAN

The foregoing measurements may be used as standards in preparing the kitchen plan. If some limitation of size, shape, or arrangement requires changes, the standard plan can be adapted

by selecting a different sink size, adding or taking out cabinet units, or making other changes. For example, if the ceiling is higher than 8 feet, the space above the 8-foot level may be boxed

Curtis Companies Incorporated

Figure 43. A pull-out board providing a work surface below counter top is useful for many purposes.

in. Corner units may be obtained to fill in if cabinets are placed along adjacent walls.

Two drawings are necessary to make the plan: (1) wall plan or elevation view of the equipment, and (2) a floor plan

to show room arrangement, doors and windows, and other space occupied by the various items.

THE WALL PLAN. In making the wall plan, or wall elevation, use cross-ruled paper, or mark horizontal lines on plain paper. Let each space equal 4 inches. All of the vertical measurements given

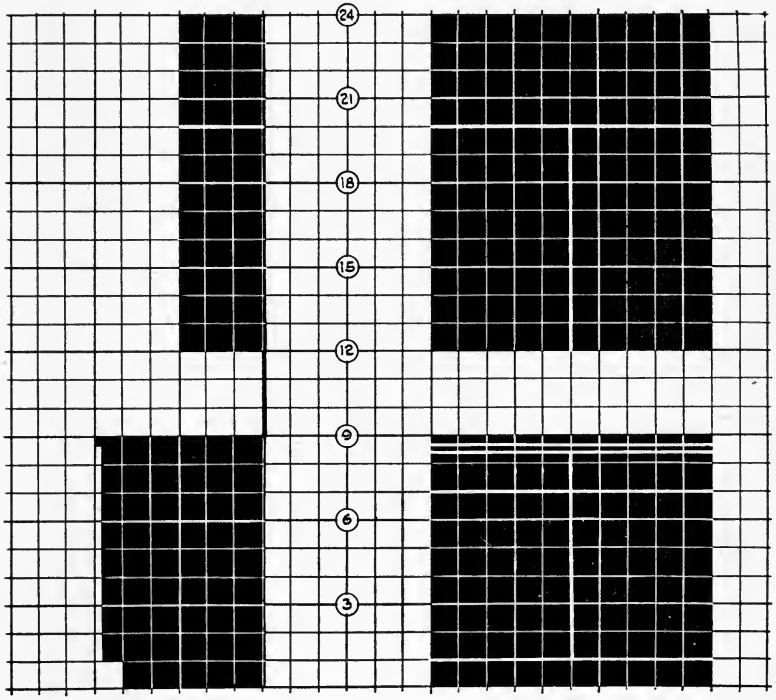


Figure 44. Side and front views of wall cabinets blocked out in 4-inch modules.

are in multiples of 4 inches. Thus 24 spaces will represent the usual distance of 8 feet from floor to ceiling. The line 4 inches from the floor indicates recessed cabinet bases; 36 inches, or 9 spaces locates the work counter level; 48 inches, or 12 spaces is the bottom line of wall cases; and 80 inches, or 20 spaces is the top of reachable wall cabinets, and door and window openings. The remaining 4 spaces, or 16 inches may be fitted with cabinets, or enclosed completely.

Begin placing equipment by locating the sink in the center of the grouping. Complete the plan by filling in base and wall cabinets, range, refrigerator, and other items. Use catalogs or other references for sizes and types of equipment. The resulting diagram will show the kitchen equipment in a single line. The floor plan will determine the most suitable arrangement in the room.

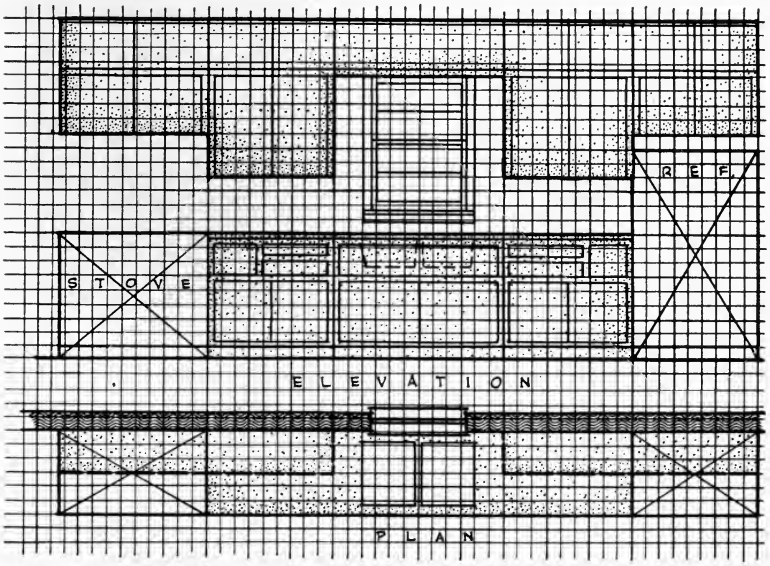


Figure 45. Planning sketch, showing wall elevation and floor plan on cross-ruled paper.

THE FLOOR PLAN. Draw the outline of the kichen to the same scale as the wall plan. Place equipment to correspond to the elevation view, except arrange the various units on two or three walls according to the most suitable type of kitchen. If the size of the kitchen is fixed, the equipment must be adjusted to the space. In planning a new kitchen the size can be made to fit the equipment. Choose a right- or left- opening refrigerator, depending on where the refrigerator is placed.

SELECTING EQUIPMENT

Kitchen equipment is commonly sold in units such as the following: (1) sink cabinets, (2) base cabinets, (3) wall cases, and

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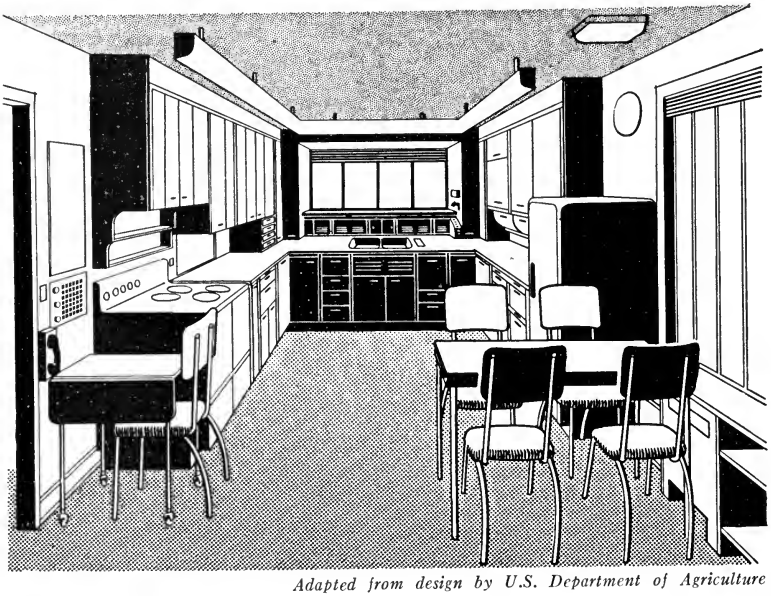
Figure 46. The kitchen work center may be placed in one corner of a larger room.



Adapted from design by U.S. Department of Agriculture

Figure 47. A complete U-type kitchen based on requirements found by research.

(4) special items for high shelving, filling in corners, and providing space for cleaning supplies and general storage. Counter tops may be a part of each base cabinet or separate pieces in lengths to cover an entire section. Choices include finished or unfinished wood, enameled steel, and combinations of metal, wood, synthetics, and glass.

Cabinets may be built especially for each job, instead of using commercial units. There is some advantage in being able to construct equipment exactly to fit the available space and to meet the owner's personal specifications. For lowest cost, the owner might build his own cabinets, using relatively low-priced materials.

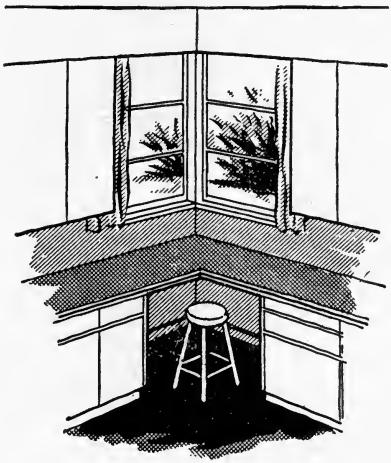


Figure 48. Work counter under corner windows.

ARRANGEMENT OF THE KITCHEN

In most plan patterns the kitchen has two outside walls. In such plans windows can be located above the sink and also in the other outside wall. At least two doors are needed, for access from out-of-doors and to the dining or living room. Other doors may be necessary to reach the basement, workroom, or other parts of the house. They should be arranged to permit passage through or across the room in a way that avoids interference with equipment and kitchen work.

Arrangements for serving meals vary according to the style

of furnishings used. A countertop table or a hinged letdown table require the least space, but, although suitable for occasional meals, neither is desirable for families with small children. An alcove or booth with a table and benches requires a space about 5½ feet square, whereas a dinette table and chairs for four persons takes perhaps 6 or 7 feet each way.

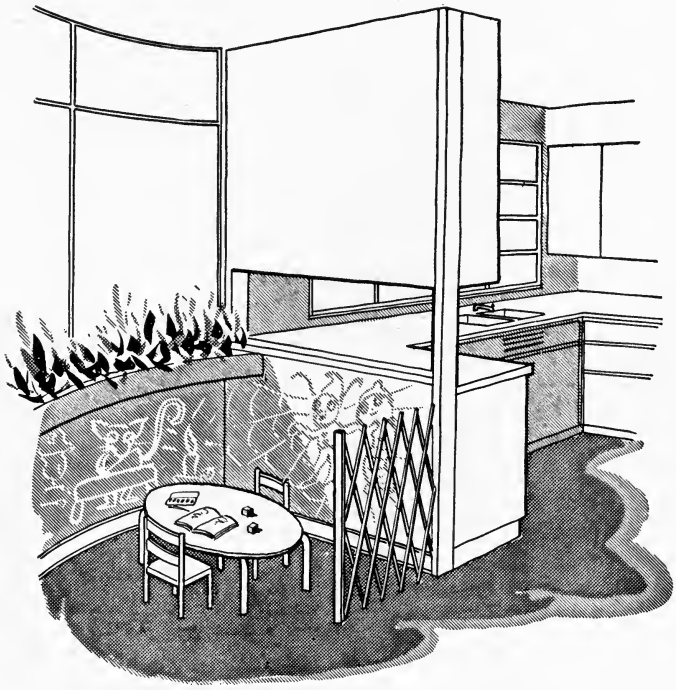


Figure 49. The kitchen plan may be adapted for various activity spaces.

Many families want enough space in the kitchen for other activities, such as a "management center" with chair and desk; room for child's play pen; or space for an ironing board.

WORKROOM

The workroom is a supplement to the kitchen. It provides space for laundry equipment, supply storage, frozen food cabinet, and a place for doing heavy-duty work. Such a room makes it possible to have two work areas—the kitchen specifically for every-

day work with food and the workroom for other household jobs. The workroom is comparable to the kitchen in many respects. It should be equipped with sink, work counters, and cabinets, fitted with appliances and equipment, and supplied with hot and cold water.

The workroom may be planned according to the same step-by-step procedure used in planning the kitchen. Plan the wall and

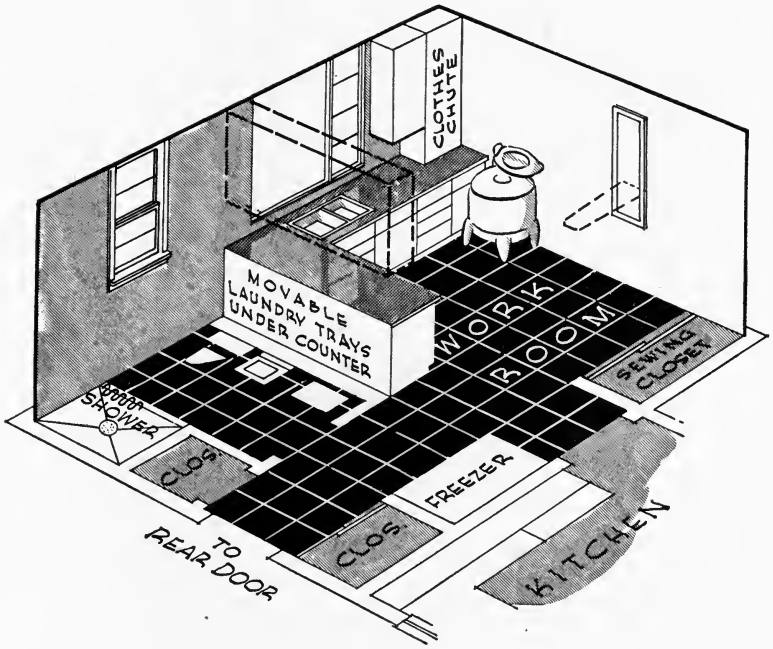


Figure 50. Farmhouse workroom for laundry, work space, and equipment; also wash-up room and closet for work clothes.

floor space for the necessary sizes, and arrange the equipment for convenience in doing the work. In many houses the workroom is often adjacent to the kitchen and sometimes combined with it, except that the two are separated by a counter, storage wall, or partial partition.

Workrooms may be used for many purposes. Laundering is the most common need. Equipment may consist of an automatic machine, clothes drier, and ironer, or a nonautomatic washer and

rinse tubs. Other uses may include canning, food processing, and preparing products for storage or for sale. Additional needs in farmhouses are for washing dairy utensils, and handling poultry, dairy, and garden products. A washup space, lavatory, and work-clothes storage may be provided.

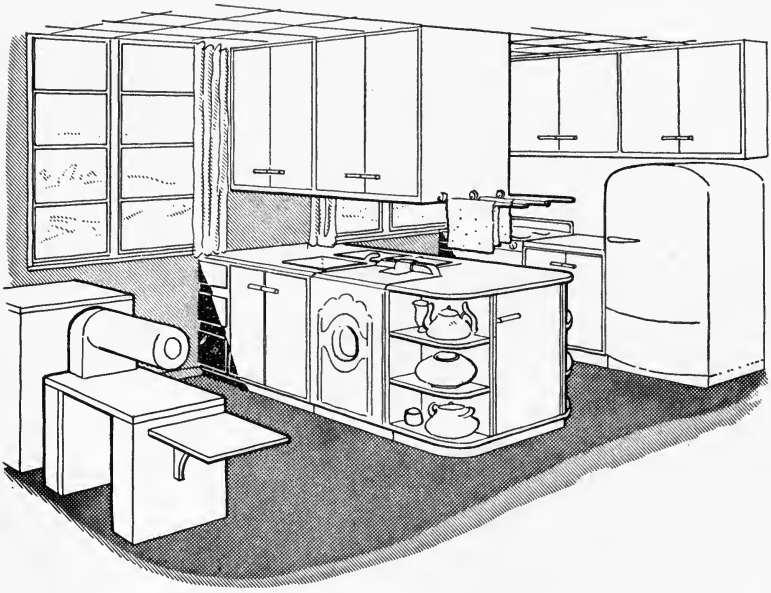


Figure 51. Combined kitchen and workroom on first floor.

If the house has a basement, it may be best to put the laundry and food storage in it. Then the first floor workroom may be used as a sewing room, play room, office, or lounging room. In houses without basements, the workroom must be enlarged, or other first floor space provided for a "utility" room for heating system, water heater, and general storage.

CHAPTER 6

Living and Sleeping Areas

Many variations occur in the way living and sleeping rooms are planned, arranged, and finished, principally because basic needs can be met by many different combinations of size, shape, and design. Strictly standard arrangements may be followed, or personal ideas may be used freely in planning. Many plan features are common to all houses. Differences are due more to personal or economic factors than to variations in normal needs. Thus, the planning problem is to develop good basic arrangements that can be modified in details to suit individual needs.

After the general plan or pattern of the house has been chosen, each room should be studied in detail and planned to serve its intended purpose. This phase of planning involves current styles, trends in furnishings and finishes, and the family's personal activities. Entertainment, family group activities, reading, study, quiet, and privacy must all be considered and provided for.

Begin planning rooms by arranging them for the best appearance, proportions, and use. Then doors and windows can be located in such a way that openings do not interfere with furniture, or with activities. "Cutouts" are useful in planning so that many different arrangements can be studied before plans are finished. Obtain information on how to furnish and finish rooms and select furniture to be certain that the rooms will be satisfactory when the house is completed.

LIVING ROOM

The purpose of the living room is to provide a place for group activities in which all members of the family take part. The most common needs are for recreation, reading, study, and entertainment of guests. This requires a relatively large room, preferably

oblong in shape, arranged to provide several centers of interest and activity.

Living rooms in small and moderate-sized houses are made from 12 feet to 13 feet 6 inches wide since this width is sufficient to place furniture along the walls and yet leave usable clear space

Pittsburgh Plate Glass Co.

Figure 52. This sunroom in a more elaborate plan is comparable in size and shape to the typical living room.

in the center of the room. This width also utilizes materials to good advantage in floor and wall frames.

Lengthwise, the living room is made from 1½ to 1¾ times the width for good proportions; desirable minimum lengths are from 18 to 22 feet. The exact size should be based primarily on what is needed for the most suitable arrangement of the usual living room furniture. The room may need to be modified to some extent by the way the "recreation area" fits the house style and pattern, and according to the other space in the plan that can be used for group activities.

If a fireplace is included, it should be placed in such manner that chairs can be grouped before it, and so the fireplace becomes a primary center of interest when in use. Locate the fireplace so the furnishings grouped in front will not be in a direct line of traffic. The fireplace occupies a space of 5 to 6 feet along one wall. Heat registers or radiators and outlets for electric appliances should be placed so as to avoid using wall space needed for furniture.

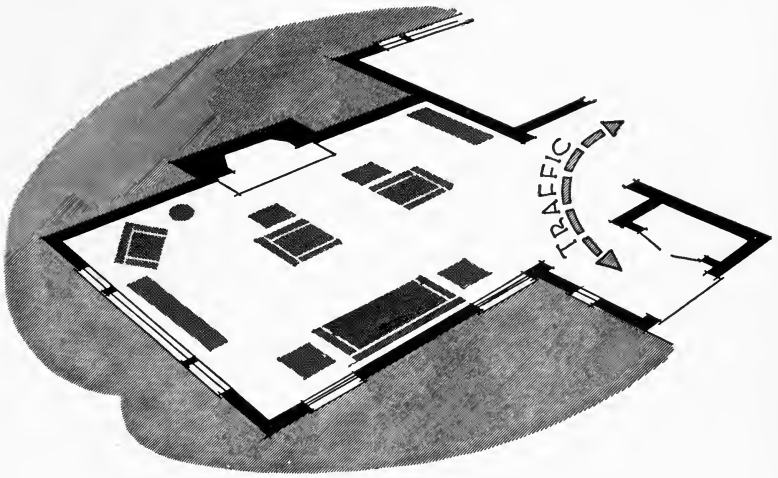


Figure 53. Living room planned to avoid traffic lines.

Usually, the living room should be made somewhat larger if it is to be used as a dining room also. A modern trend is away from separate rooms for each purpose, and toward an "open" type plan. Wide openings, movable or folding partitions, and partial divisions or storage walls provide some separation and yet give the effect of spaciousness. In this way the living room may be combined with the dining room at one end or in an ell or alcove in a way that permits each part to be furnished individually.

Supplements to the living room. If the house plan permits, it is well to have an indirect entrance to the living room from the outside. An enclosed porch, entryway, or entrance hall may be used. Cold drafts are thereby avoided in winter, and persons com-

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Figure 54. A formal fireplace.

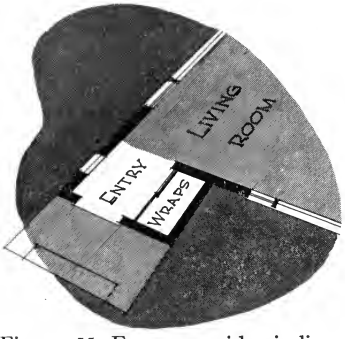


Figure 55. Entry provides indirect entrance and closet for wraps.

ing into the house need not interrupt activities in the room. A closet near the living room and also near the entrance is convenient for storing coats, visitors' wraps, and articles often needed in the living room.

The sunroom, "den," study, or library is a secondary living room. Few such rooms are included in small houses, either because the owners do not want them, or because limitations of space or cost prohibit them. When included, these rooms are relatively small.

DINING ROOM

The necessity for reducing the size of a house to keep within the limits of cost is a principal reason for omitting the dining room. Preference may be for other solutions to the problem of

space for serving meals. These are: (1) combined living and dining space, (2) dinette or alcove adjacent to the kitchen, and (3) meal service in the kitchen. For the more elaborate houses both a separate dining room and serving place in or near the kitchen may be planned.

U. S. Gypsum Co.

Figure 56. Dining room. Note contrasting wall finishes.

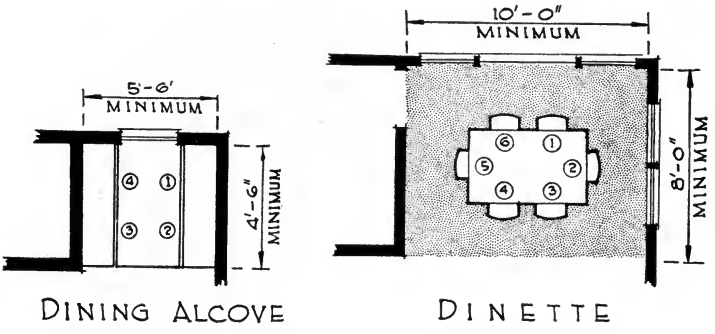


Figure 57. Space requirements for alcove and dinette.

A minimum space of 5½ feet square is needed to seat four persons in an alcove or booth-type arrangement furnished with benches and a movable table. About the same space is required to serve four persons at a card table. Dinette furniture for six persons can be planned in a room about 8 feet square. For convenient service, the dinette should be in conjunction with living room or kitchen, without a partition wall between the serving space and the adjoining room.

Dining rooms, whether separate from the living room or combined as an ell or an alcove, should be planned with space for a full-sized table to serve at least 6 persons. Allow 24 inches of table space for each person and 36 inches between the table and other furniture or wall. Other dining room furniture together with space for serving requires a square or slightly oblong room having an area of 120, or more, square feet.

Direct connection between dining space and kitchen, and convenient access to the living room are necessary. A closet should

Douglas Fir Plywood Association

Figure 58. Bedroom design.

be located in or near the dining room for storing linens, table leaves, card tables, and electric appliances. Since the dining room is used relatively few hours each day, its usefulness may be increased by planning furniture, built-in equipment, and storage space to make the room convenient for study, reading, and sewing, or to supplement the living room in other ways.

BEDROOMS

A house needs three bedrooms for a typical family of parents, boys, and girls. The usual recommendation is that not more than two persons should share one bedroom. More rooms may be needed to provide a separate room for each child, guests, or

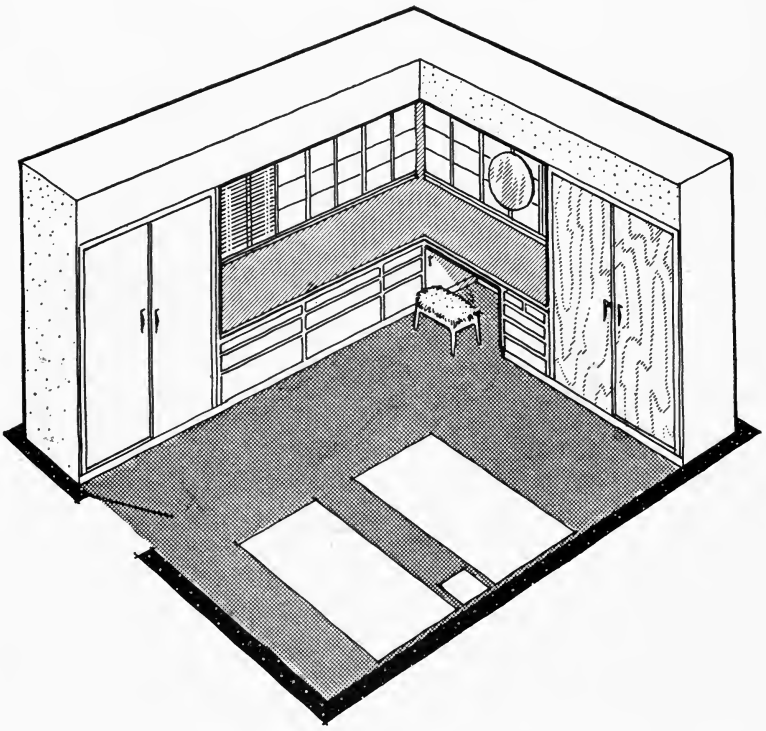


Figure 59. Bedroom with corner windows and built-in furniture and closets.

persons not in the immediate family. From three to five bedrooms would be required to provide such accommodation. In contrast, small houses may have only one or two bedrooms; few new houses have more than three.

The size of a house can be made to conform to cost limits and family needs by varying both the number and size of sleeping rooms. Generally, the practical minimum is two bedrooms. In any case, it is desirable that additional sleeping space be provided in a finished attic, enclosed porch, sunroom, or study which might be used at least for temporary or emergency needs.

U. S. Gypsum Co.

Figure 60. Bedroom with modern window and furniture detail.

About 100 square feet is the typical minimum size for a fully furnished bedroom. A single bed, a chair, and a dresser can be accommodated in less than 100 square feet, but more space is desirable. The planning problem is to locate bedrooms convenient to the bathroom and to provide adequate storage, suffi-

cient light and air circulation and space for attractive arrangement of furnishings. In typical plans most bedrooms have two outside walls; open into a common hallway; and have one or two clothes closets.

Scaled cutouts representing furniture can be used to good advantage in planning. Provide wall space for a double bed or two single beds in such a manner that it will not be necessary to place a bed directly across a window.

BATHROOM

The one bathroom normally included in the small house should be readily accessible from the bedroom through a common hallway. Usually one wall should be an outside wall, and a window should be provided. The bathroom should have only one door; place it so the door can swing open a full 90 degrees.

The minimum bathroom size is 5 by 7 feet, or 35 square feet, for tub, toilet, and lavatory. More space is desirable to provide for the storage of towels, supplies, and room for dressing table or countertop cabinet. A shower can be installed over the tub, or a separate shower compartment may be used.

Most bathtubs are 30 inches wide and 4½, 5, or 5½ feet long, although some tubs are square, occupying a floor space about 4½ feet each way. Usually a "recessed" tub is preferable. It is set in an alcove, enclosed at the ends, so that only the front is exposed in the room. Locate the tub so the end having the fixtures is accessible for repair, through the wall of a hallway, closet or bedroom. If possible, avoid placing the tub under a window, because it is then difficult to reach the window.

Toilets are about 28 inches wide. Allow 4 feet out from the wall for the fixture and space in front. The toilet should be within 2 or 2½ feet of the drain stack to provide a suitable connection. Lavatories vary in size from about 18 to 24 inches square.

Bathroom plans are relatively standard in arrangement. If the tub is across the narrow wall, the toilet and lavatory are placed along the adjacent wall opposite each other. If the tub is recessed along one side, the other fixtures should be opposite the bathtub. Other arrangements can be used if the room is larger than the minimum size.

Several methods are used to increase bath and toilet facilities and provide greater convenience in the home. The "divided" bathroom or compartment arrangement is obtained by dividing the space so as to place the bathtub in one small room or compart-

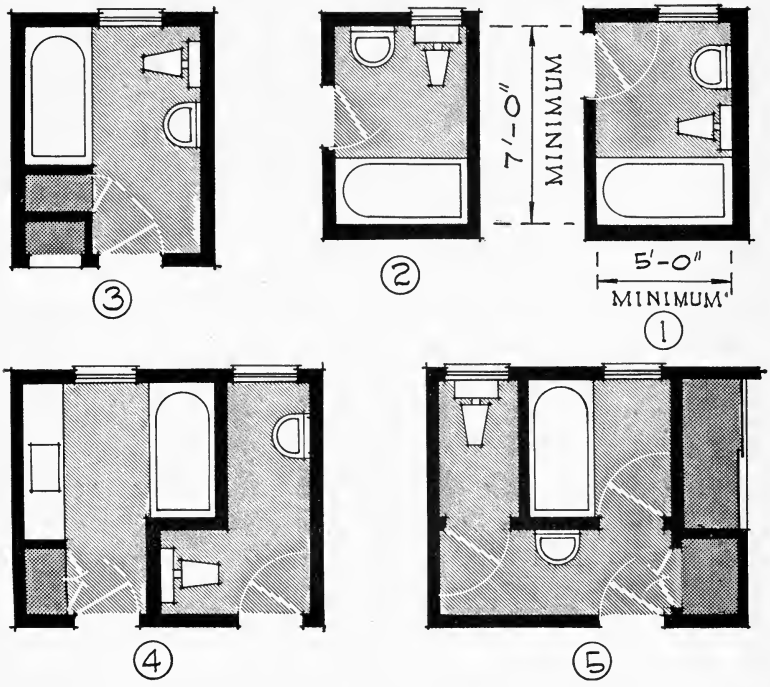


Figure 61. Bathrooms. Three single baths and two divided or 2-compartment rooms.

ment. Then, a separate space is planned for the toilet and lavatory. Nearly the full value of two bathrooms can be obtained by having small lavatory rooms on either side of the "tub" room, each fitted with a toilet and basin.

It is also convenient to have an extra washbasin in one or more bedrooms; or a basin and toilet in a small room readily accessible from the kitchen or workroom. In more elaborate houses a full-scale bathroom or a lavatory room with toilet and washbowl might be provided for each bedroom.

In two-story houses, it is convenient to have the "half bath,"

Ingersoll-Rand

Figure 62. Bathroom unit of complete "utility unit" with all fixtures and piping on one wall.

"powder room," or lavatory and toilet room on the first floor, if the bathroom is on the second floor. A space only 4½ to 5 feet square is sufficient for toilet and lavatory. In remodeling an old house, particularly on the farm, it may be an advantage to locate the bathroom on the first floor if only one can be installed.

CLOSETS

Closets built as a permanent part of the house are the most generally useful storage spaces for all purposes except for such special needs as kitchen storage, shelves, bookcases, dressers, and chests. For most uses closets should be 24 to 28 inches deep, front to back. The width depends on the amount of storage needed

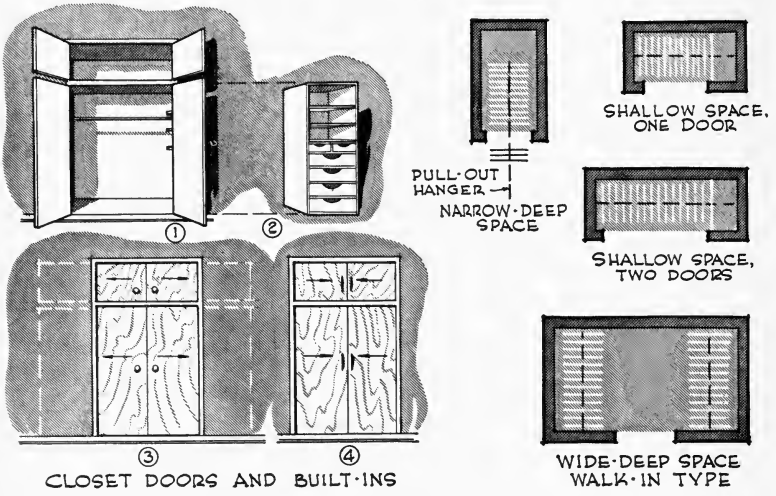


Figure 63. Suggestions for design of closets.

and the way the house space can best be utilized. From 3 to 4 feet of garment hanger rod is usually enough for one person's clothing. Rods should be 64 inches above the floor for garments on hangers. One or two shelves can be placed above the rod. Sometimes a tier of shelves extends the full height of the closet across one or both ends. Most closets should be equipped for general purpose use, but one or more may be fitted with shelves, trays and drawers. A 2-foot door is suitable for small closets. Wide closets may have double or French-type doors, or sliding doors to give better access. If space is available for closets deeper than about 2½ feet, a "walk-in" type may be the best solution. Then the space may be equipped with two hanger rods, or shelving on each side of an aisle.

Storage space should be specially fitted for some uses. For

Lustron Corp.

Figure 64. Typical closet arrangement. Wide space has sliding doors.

towels, bedding, and linens, the entire closet or cabinet may be made up of drawers and shelves. Compartments may be needed for such items as card tables, ironing board, brooms, and dust mops, and dining extension leaves. Cleaning closets, separate from other storage space, are convenient for sweeper, brushes, and cleaning supplies.

Facilities for storage may be increased in old houses by installing

Curtis Companies Incorporated

Figure 65. Built-ins may be used effectively for many kinds of storage.

built-in cabinets or a row of closets made by taking a 30-inch space from one side of a large room. Much useful storage can be obtained by utilizing space that would otherwise be wasted. Examples are space between a chimney and a corner, at the end of a bathtub, and above and below stairways.

Seldom-used items may be stored in attics, storerooms, or dry

basements. Articles used frequently should be kept near the place where they are used. For example, locate coat and wrap closets

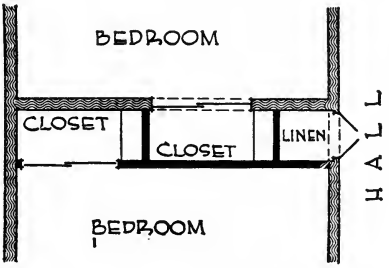


Figure 66. Closet strip between bedrooms. Suitable for new or remodeled house. Minimum closet, 2 feet wide.

near the entrance, personal clothing and possessions in bedrooms, linens and bedding convenient to the bedroom hallway, and toilet articles and towels in or near the bathroom.

CHAPTER 7

General Planning Problems

Thus far only basic needs and requirements have been considered in the discussion of planning. They determine the general plan of the house and the arrangement of each room. Sizes are determined by the space needed for each function; therefore, size is the result of planning.

Shape, style, and appearance are the result of variations from a basic plan which are determined by the way rooms or units are arranged, by proportioning, and by the use of colors, textures, or finishes. Thus, as a step between house planning and the study of materials, construction, and other factors, it is necessary to consider the variable features which characterize houses, both individually and by types. These include correct sizes; the choice between one-story and two-story houses; useful plans for attic, basement, porch and garage; and factors that affect appearance.

THE SIZE OF THE HOUSE

Two common measures of size are used in describing a house: The area of floor space, and the number of rooms. Neither gives a satisfactory indication of capacity or value. Space may be wasted in a large house and used efficiently in a small one. Rooms may be large or small; frequently fewer larger rooms may meet requirements better than more rooms of smaller size. Minimum sizes that barely meet the needs may have to be used to come within limits of cost; more space may be desirable if it can be afforded.

It is not practical to use average sizes except as a general guide, since the requirements of each room should establish its size.

Likewise the number of rooms should be based on needs for family living. Tables 2 and 3 indicate the typical range of house and room sizes, areas and use of space. The sizes are not necessarily recommended; they merely indicate typical practices.

All single family houses have certain needs in common for kitchen, living room, and bedrooms. Few houses have only two rooms. Then kitchen–dining needs are combined in one room, and living and sleeping accommodations in the other. A typical 4-room house has two bedrooms. Five-room houses usually have

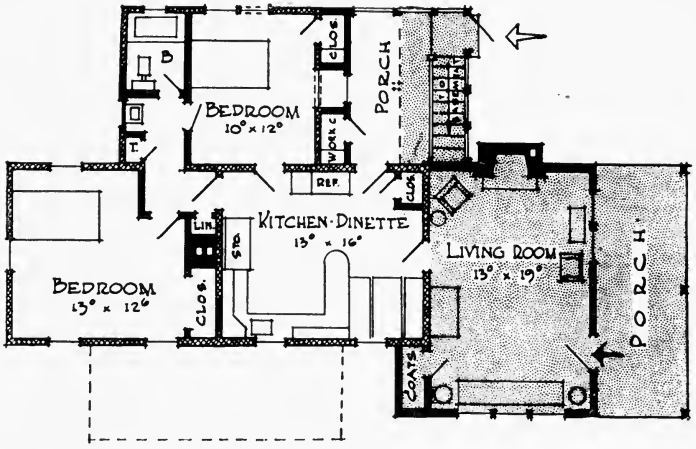


Figure 67. Typical floor plan of small low-cost house, with shaded portion to show addition made in remodeling.

either a separate dining room or a first floor utility room, or they may include three bedrooms. Six-room houses usually have three bedrooms.

Total area includes the major room spaces as well as the space occupied by halls, stairs, bathroom, closets, and walls. Total area, as well as cubic volume, is useful mainly for comparing one house with another.

NUMBER OF FLOOR LEVELS

The following combinations can be used in arranging space, either to place all the rooms on one floor level, or to utilize

TABLE 2. TYPICAL HOUSE AREAS AND DIVISIONS OF SPACE

Plan No	Source	Type	Rooms, no.	Basement, sq ft	Finished Area, sq ft	Use of Space, in Area and per cent of Finished Area for						
						Living and Dining		Sleep and Rest		Kitchen and Work Space		Other
						Area	per cent	Area	per cent	Area	per cent	per cent
1	Promotion booklet	2-story	6	576	1,152	319	27.6	383	33.2	132	11.4	27.8
2	Farm magazine	3-level	5	422	1,060	286	27.0	442	41.6	165	15.3	16.1
3	Farm magazine	1-story	4	none	1,000	260	26.0	378	37.8	230	23.0	13.3
4	Builders' journal	2-story	7	816	1,692	407	24.2	912	54.0	168	9.9	11.9
5	Government bulletin	1-story	6	1,050	1,050	315	30.0	456	43.5	184	17.5	9.0
6	State bulletin	1-story	5	816	978	363	37.2	400	41.0	82	8.4	13.4
7	Woman's magazine	1-story	6	none	1,300	400	30.8	672	51.6	176	13.6	4.0
8	Trade association	1-story	5	none	872	364	41.5	312	35.8	120	13.7	9.0
9	Lumber company	1-story	5	588	866	293	32.1	373	40.8	160	17.5	9.6
10	State university	1-story	6	800	1,456	390	26.8	656	45.1	336	23.1	5.0

The plan analyzed from each source is not necessarily characteristic of other plans from the same source. "Other space" denotes hallways, entry, landings, and other finished space not in principal rooms, baths, or closets. Calculations are approximate.

TABLE 3. ROOM SIZE AND AREA IN TYPICAL HOUSES, BASED ON 10 PLANS

House No.	Width and Length in feet and Area in square feet for Each Principal Room							
	Living Room	Dining Room	Kitchen	Bedroom 1	Bedroom 2	Bedroom 3	Bath	Other
1	11×19=209	10×11=110	11×12=132	11×12½=137	10×11=110	8×9½=76	6×7=42	
2	13×22=286	With kitchen	11×15=165	11×13=143	10×13=130	.....	5×8=40	
3	13×20=260	With kitchen	10×13=130	13×14=182	10×13=130	.....	6×6=36	10×10=100
4	13×23=299	9×12=108	9×12=108	12×16=192	12×12=144	12×12=144	5×7=35	5×7=35 10×16=160
5	13×17=221	6½×13=84	9×13=117	10×12=120	9½×12=114	9½×12=114	5×7½=37	
6	11×23=253	11×11=121	7½×11=82	10×13½=135	11×11½=126	.....	5×8½=42	
7	17×18=306	8×11=88	11×16=176	11×15=165	11×14=154	10×11=110	5×7=35	5×7=35
8	13×18=234	10×13=130	10×12=120	12×12=144	12×12=144	.....	6×8=48	
9	11×16=176	9×13=117	9×16=144	11×13=143	10×13=130	.....	5×7=35	
10	15×26=390	With living room	10×15=150	10×15=150	10×15=150	10×11=110	7×8=56	12×12=144

Rooms analyzed in this table are from plans corresponding to the listing in Table 2.

more than one level: (1) one-story, with all rooms on the ground-floor level; (2) two stories, usually with bedrooms and bath on the second floor; (3) one- and one-half story, to utilize space on

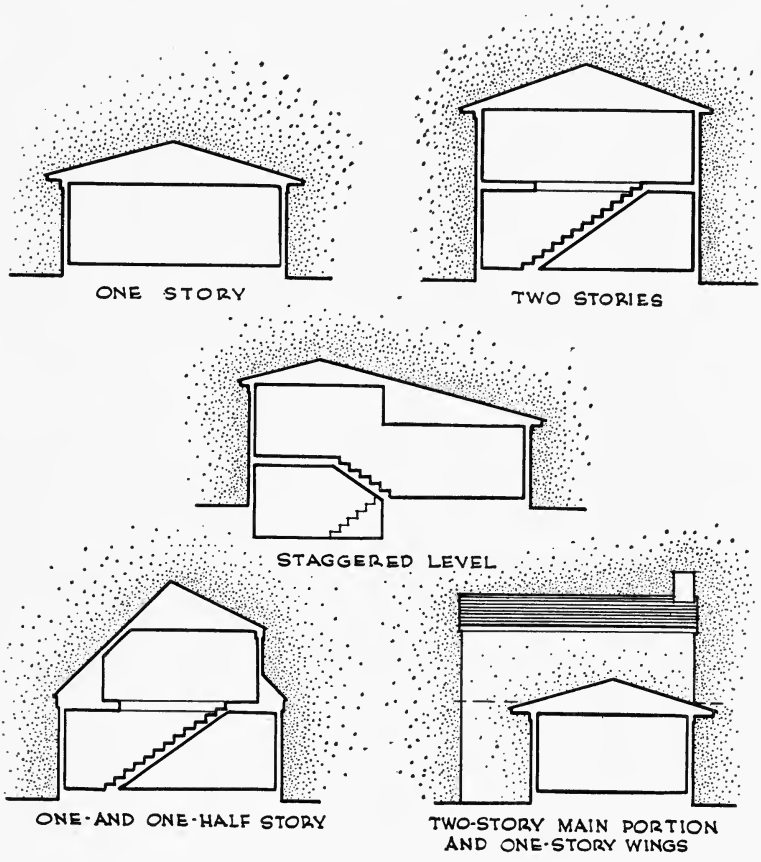


Figure 68. These outlines illustrate the common types of houses according to height.

the second floor under relatively low rooflines and in dormers; (4) two-story main portion and one-story wings and (5) a staggered level having kitchen, dining and living space on the ground floor, a partial basement only a few feet in the ground, and bedrooms above the basement.

Custom and habit are important factors in determining which

arrangement is chosen. Each type has advantages or disadvantages in economy, convenience, appearance, or arrangement. In most cases the values of one arrangement are balanced by desirable features of another, and so the decision should be based largely on preference, or circumstances dictated by location. Current trends appear to favor one-story houses. Usually one-story types are preferable for small houses of 4 or 5 rooms; six-room houses may be arranged on one level or two.

Costs are about the same for equal space and quality in the different heights. Savings in foundation, roof, or outside wall surface in 1½ and 2-story houses are offset by the simpler construction of one-story types with lighter framework, elimination of stairways and omission of dormers. Modern heating systems, and ceiling and wall insulation make it possible to heat homes economically, regardless of the way the rooms are arranged.

SUPPLEMENTARY FEATURES

Many new homes are built without attics, basement, garage, or porches. This is done in part to reduce the cost, and partly because some of these spaces are not so essential as in the past. For example, many families do not retain possessions of a type formerly stored in attics. Automatic forced-circulation heaters may be placed on the ground floor instead of in the basement. The need for porches depends on location and climate. In built-up sections in the North, a porch is often not used effectively.

In contrast to these points, finished attics utilize space to good advantage for storage; if the basement is omitted, other space must be provided to take its place; entrances may need the protection of a porch; and it is convenient to have a garage attached to the house.

Attic. The attic in small houses has little usable space and it should generally be left unfinished. If 6, or more, feet of headroom is available in the central portion, it may be desirable to install stairs and flooring and make use of the space for storage. If enough of the attic area has sufficient headroom, it may be insulated and finished as a playroom, study, or bedroom. Usable space should have both natural and artificial light; one or more dormer windows may be needed. Plan for a guard rail around the stairway opening. Build shelves under the lower portion of the roof, and enclose part of the space for closets.

Basement. Whether or not the house should have a basement depends on personal choice. Cost is a secondary consideration outweighed by other factors. The total cost of a house is about the same with or without a basement if equal facilities are provided. If the basement is omitted, the heating plant, laundry, and storage needs must be provided for in a room on the first floor.

The basement is most useful to accommodate the heating system and fuel storage, if solid fuel is used. Heat pipes or air ducts can be installed conveniently. The basement also provides useful

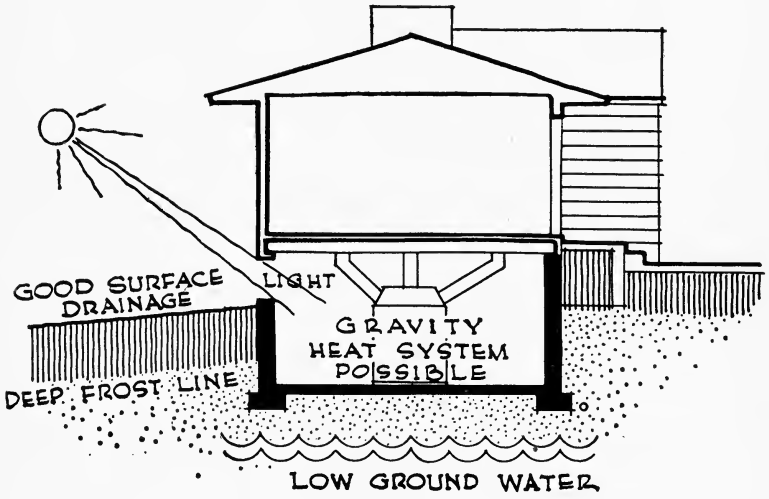


Figure 69. A basement is most useful if good drainage, ample light, and low water table assure dryness.

space for laundering, drying clothes, and storing fruits and vegetables. Some space may be utilized for recreation room and a home workshop.

In locations where it is difficult to obtain good drainage, it may be best to omit the basement. Waterproofing may be necessary on the outside walls to exclude ground water. The basement is likely to be damp during part of the year, thus limiting its usefulness for some kinds of storage.

If a basement, or partial basement is to be included, it should be planned so it is readily accessible from first-floor rooms. Often the plan can be arranged to provide a ground-level entrance.

Usually, the outlines of the first floor determine the basement plan. Locate chimney, stairs, water and drain pipes and supporting posts or partitions according to first-floor requirements. A recreation room should be separated from the rest of the basement by tight partitions. The coalbin should be tightly enclosed. Space for vegetable storage should be insulated against heat from the furnace.

Owens-Illinois Glass Co.

Figure 70. Attractive recreation rooms may be planned either in the basement or at ground level.

GARAGE. The garage is planned in conjunction with the house in most new designs. Generally it should be connected to the house, either directly by hallway, or through a covered passage, entry, or breezeway. In some plans the garage is attached as a wing or as an ell. The roof may be made high enough to permit a second-floor room over the garage. There are disadvantages in having a basement garage because of the steeply graded driveway, and problems of drainage and insulation; however the garage may be located under the house on a sloping lot.

Doors should be the overhead type or other types that are readily closed. Keeping the doors closed tends to conserve heat and gives a neater appearance. It is best to avoid an arrangement in which the garage doors face the street. The wall between garage and house should be lined with a fire-resistant material such as gypsum board for protection against fire hazards. Minimum doors are 8 feet wide and 7 feet high. Floor space for one car should be at least 10 by 20 feet; 12 by 22 feet is better. Two

Figure 71. Garage attached to house by breezeway.

cars can be stored in a 20 by 22 foot garage. More space is needed for a work bench or storage cabinets.

Porches. In most localities the house entrances should be protected from the weather. This can be done either by a porch, or by a hood or projection above the doorway. The style of the house will determine the type, size, and shape of porch. For example, an H-shaped house may have the space roofed over to connect the wings on either side. Sometimes a porch is formed by an extension of the main roof. In other cases, it is roofed separately as an attachment to the house.

A small covered terrace may be just large enough so one or two persons can stand on it and yet permit the screen door to open. This would require a minimum size of about 4 feet by 6 feet.

Porches should be at least 8 feet wide if partially or completely enclosed with screens or glass. An enclosed kitchen porch is useful as a work room or for serving meals in mild weather. Although enclosed porches may serve to provide temporary bedroom space, the modern plan seldom includes porches designed especially for sleeping.

Weyerhaeuser Sales Co.

Figure 72. One and one-half story house showing good design of porch and garage.

Porches are often omitted on houses in cities where proximity to the street, traffic, noise, or dust limits their use. If used under such conditions they are more useful if placed at the side or at the back of the house. Greater privacy is obtained, and adjacent lawns can be developed as outdoor living areas.

CHIMNEY AND FIREPLACE LOCATION. If a fireplace is to be built, its location may decide the position of the chimney. An "inside" chimney is usually best for convenient connection from a central heating system; it is less expensive, since common brick is used throughout; it is usually easier to obtain a watertight junction

if the chimney comes through the roof near the ridge; and some of the heat from flue gas is utilized to warm the house. In comparison, the outside chimney may give a desired appearance effect; the fireplace location may require an outside chimney; and space within the house is saved if the chimney projects beyond the house wall.

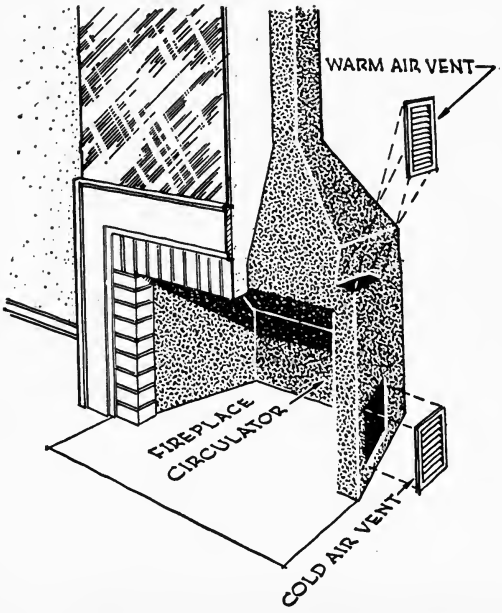


Figure 73. The fireplace may enclose a metal circulator for more effective heating.

Fireplace plan. A fireplace should be effective as a heating device, with the proportions of width, height and depth that assure correct draft. Masonry fireplaces should be lined with firebrick, or a metal inside form can be used instead of masonry, to combine good construction with more effective heating.

Windows. The size, shape, and type of windows should be considered both in room planning and for appearance. Choices include wood or metal sash; double hung, sliding, or hinged types, or fixed sash; a single glass or several small panes in each sash; single

or double-strength glass or plate glass; and single or double-glassed windows. The choice depends on cost, available stocks, and desired appearance.

Double-hung two-sash windows are the most common type. They should be weatherstripped, and balanced by metal springs or friction devices, rather than by weights and cords.

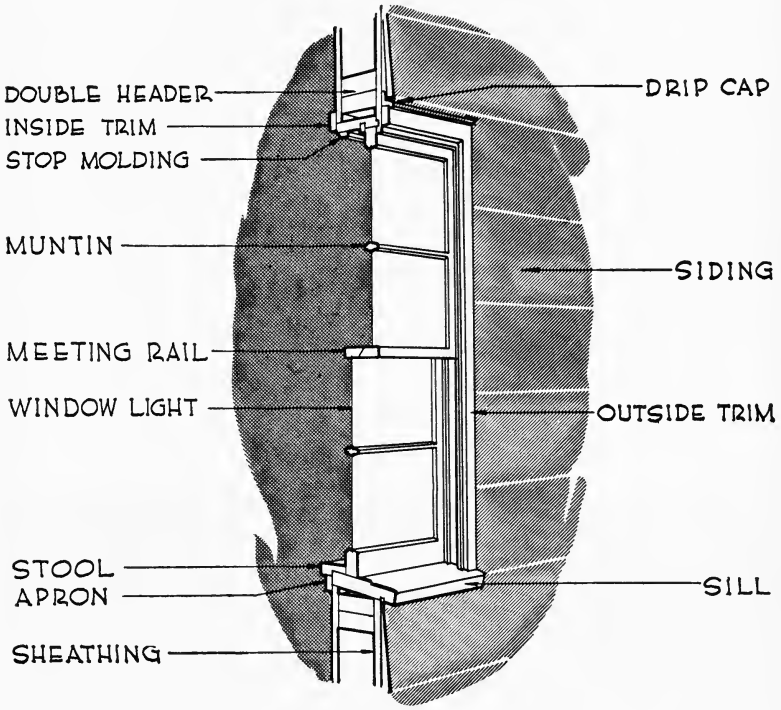


Figure 74. Typical window details.

Doors and doorways. Plans can often be improved by giving thought to the direction in which the doors swing for best convenience, and to the selection of suitable sizes and types. Sizes depend on the use; varying from 2 feet wide for small closet doors, to 3 feet for front entrance doors. Frequently, doors are not needed between rooms used for daytime living. An archway or plain rectangular opening may be the best solution.

APPEARANCE FACTORS

Although a given floor arrangement may be used with many different house styles, the exterior of a house is closely related to the plan in various ways as, for example, in the variations in one-story and two-story types, compact and "spreading" arrange-

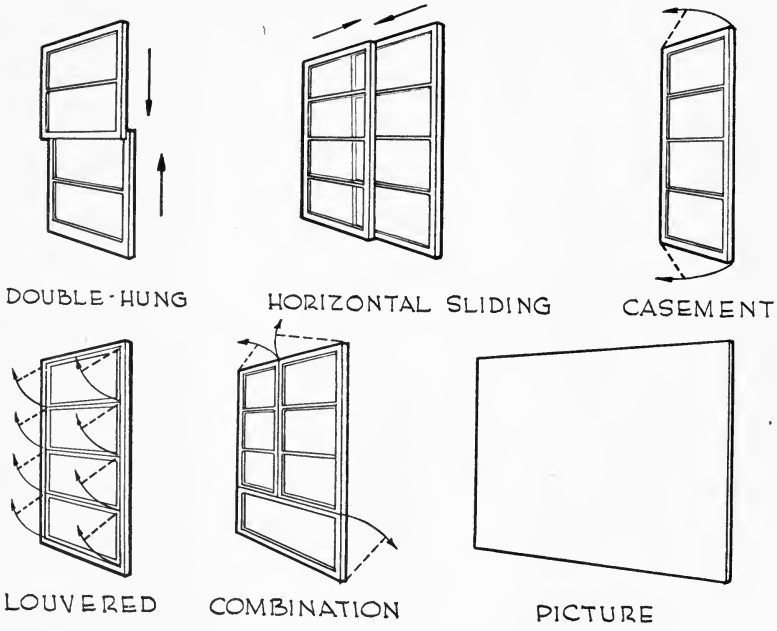
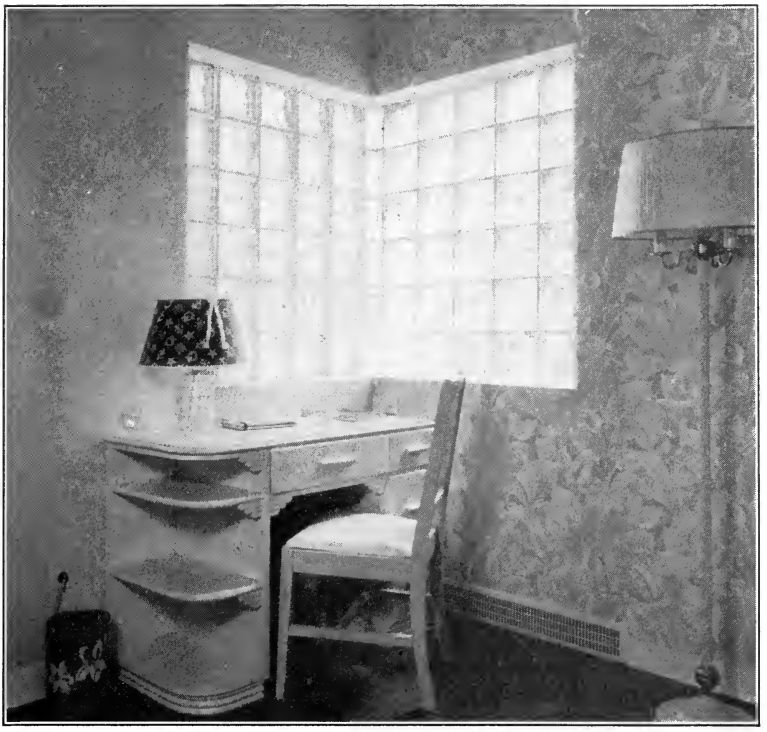


Figure 75. Common window types.

ment, roof slope, distance of floorline above the ground, and the size and position of windows.

To the student of family housing, the most important problem is to obtain a functional arrangement and an economical structure. If a house is planned for the use of space it can be made attractive in appearance. It is the province of qualified designers and architects to develop exterior styling to conform to the principles of effective design.

Distinctive types or "styles" are derived as a result of such influences as climate, materials, abilities of craftsmen, or the wide acceptance of designs produced by prominent architects. Few



Pittsburgh Plate Glass Co.

Figure 76. Glass blocks may be used effectively instead of plain glass in some cases.

examples of authentic "period styles" are found in current construction, because local adaptations of basic designs are made to secure individuality among houses in a group or to utilize a variety of materials, colors, or decorative features.

Although individuality in house design is desirable, it is usually best to select houses not radically different from those prevailing in a community. But it is important to consider the effect of appearance factors when choosing designs and avoid those which are unsuitable.

Regardless of the materials used, or the preference for a given style or type, the most satisfactory effect usually is obtained if the following characteristics are emphasized: (1) Simple lines, free from "gingerbread" or unneeded decorative effects, (2) sub-

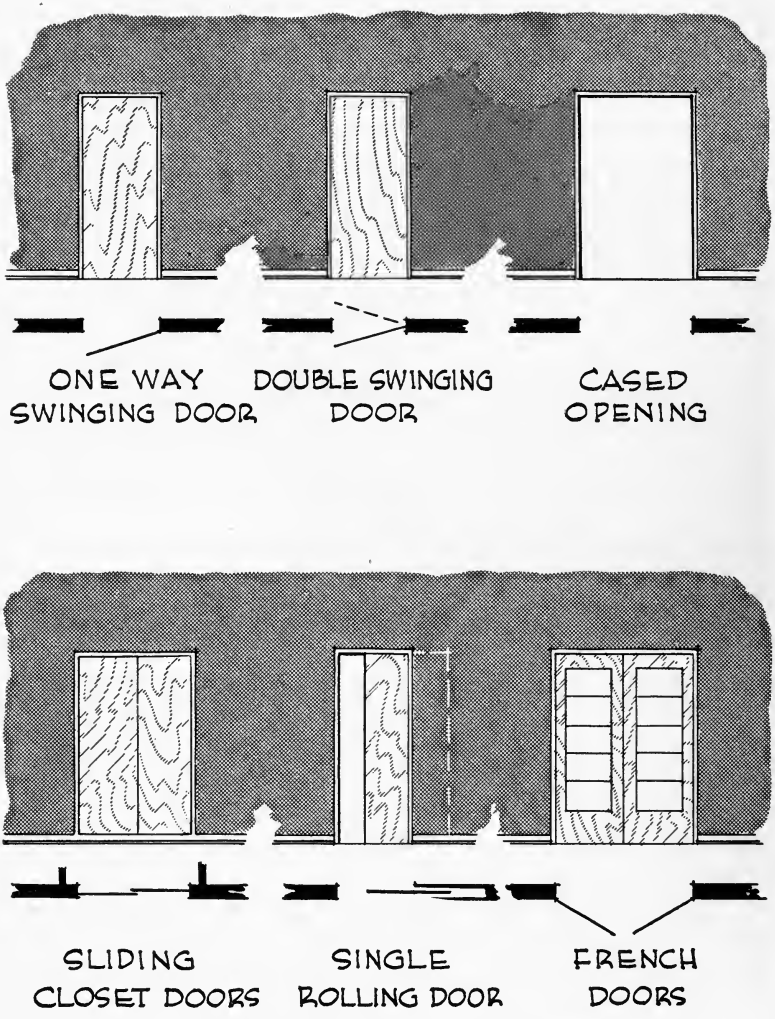


Figure 77. Common types of inside doors.

Curtis Companies Incorporated

Figure 78. Exterior door and trim.

Weyerhaeuser Sales Co.

Figure 79. Distinctive styling is obtained by low foundation, wide eaves, wide siding, low roof pitch, and massive chimney.

Douglas Fir Plywood Association

Figure 80. Effective styling in a flat roof design.

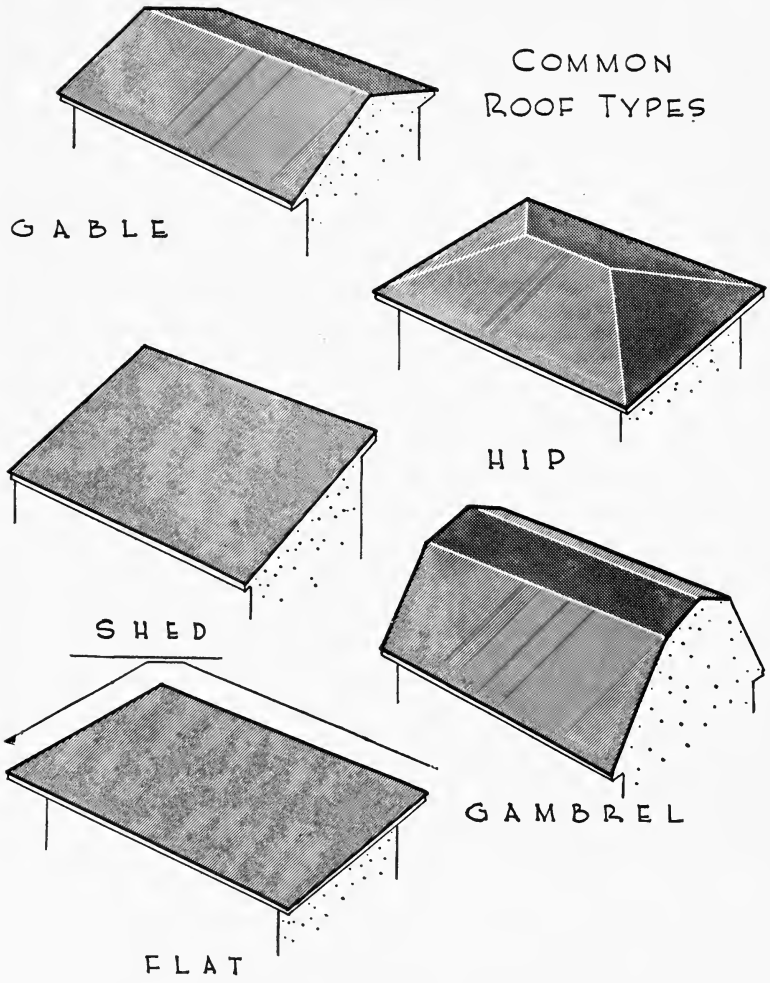


Figure 81. Identification of roof shapes.

stantial appearance, (3) natural use of materials, especially to avoid using one material that imitates another, and (4) a low-setting effect which minimizes height. Some of the more important features are:

Roof shape. The gable roof is the most common; hip and flat roofs are often used. Low roof slopes reduce the apparent height.

Roof projection. Practices vary from wide projections which protect windows from rain and serve to shade the house in summer, to very narrow projections formed by moldings and roof gutters.

Foundation height. Generally the height should be minimized. Basement walls should extend about 24 inches above the ground; 16 inches is about the minimum for conventional construction. Plantings tend to merge the house with the ground. Sometimes the site may be graded higher in front of the house.

Wall surfaces. It is generally preferable to emphasize horizontal rather than vertical lines. This can be done by wide siding or wide-spaced shadow lines; broadened chimneys, fireplaces, steps, and entrance landings; siding applied without cornerboards; windows in groups of two or three, and building sheets used as plain panels.

CHAPTER 8

Planning for Remodeling

Remodeling is the most common means of improving housing. Planning principles are much the same for remodeling as for planning new houses; differences are due mainly to the fixed walls, the size and the shape of rooms, and the condition of the old house. Within these limits, it is usually possible to rearrange space into basically good patterns and improve construction, finish, and equipment according to standard recommendations.

Houses must be remodeled from time to time as requirements and preferences change, new materials and equipment come on the market, and repairs become necessary to offset damage due to use, moisture, decay, insects, and wind. Old houses become obsolete and less desirable as new styles become popular and as research develops better methods and new ideas for comfort, convenience, and efficiency.

PURPOSE OF REMODELING

Remodeling is done to prolong the usefulness of a house, salvage remaining value, make improvements, and bring the house up to present-day concepts of adequacy. The most common deficiencies include: (1) inefficient use of space, (2) not enough space, (3) bad repair, (4) lack of equipment and utilities, (5) inadequate safety, protection, comfort, and convenience, and (6) outmoded appearance.

Economy is important; remodeling cost should be much less than the cost for new housing of comparable quality. This may limit work to the least expensive changes, or to temporary expedients that might not be justified in long range planning. In a study of complete remodeling, attention should be given to evaluating

the house as to its worth for remodeling and to developing a practical improvement program.

Douglas Fir Plywood Association

Figure 82. Old house remodeled. See Figure 8 for original condition.

EVALUATING THE HOUSE

The decision to remodel depends on the condition of the house and what is necessary to make it modern, habitable, and safe. It is relatively easy to decide if a house is worth remodeling or if it is so nearly worn out as to be worthless. Borderline decisions are much more difficult. Then it is necessary to analyze each part as to condition, needed changes, and probable costs. The suggestions given in Chapter 17 should be followed in judging a house. Most owners should rely on architects, consultants, or contractors for recommendations and advice before starting an extensive program.

Sometimes most of the old house must be demolished, and only the salvaged material, excavation, and foundation can be used. Then the job is essentially one of rebuilding. Heavy expense is involved in replacing foundations, framework, and chimneys.

Moving stairways, installing heating plants, or reshaping rooflines are among the more difficult changes. By comparison, it is quite easy to replan rooms and add insulation, new surfaces, built-in equipment, and appliances.

The disadvantages of remodeling should not be disregarded. The cost may be more than the improvement is worth. The house is still old; original parts may not last as long as the additions;

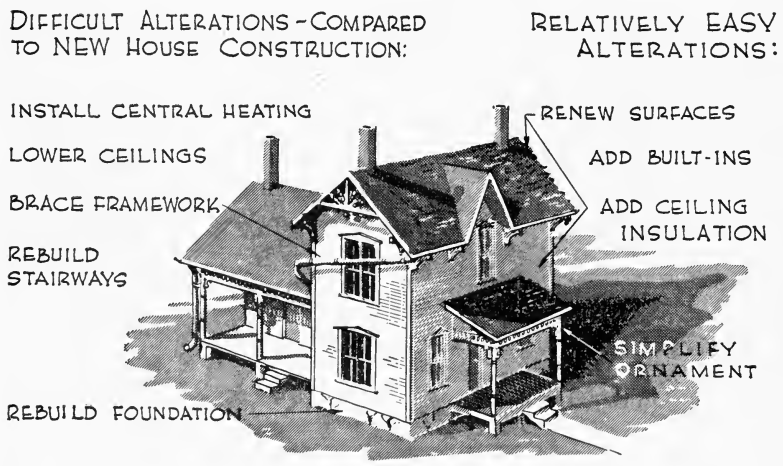


Figure 83. Typical old T-shaped house, with list of probable remodeling needs.

and the size and style may not lend themselves to modernization. If the community is increasingly used for industrial or commercial purposes or is declining as a residential area, it may be poor economy to remodel for individual family use.

FACTS NEEDED TO MAKE PLANS

Detailed plans are not needed for minor repairs and changes. The owner and workmen can agree on what is needed. The problem is to match the new materials, qualities, and finishes to the old parts. Complete remodeling requires a program, plans, and descriptions. A long-time plan should be made, even if only part of the work is to be done at once. Then each later improvement can be fitted into the final scheme. Detailed plans should

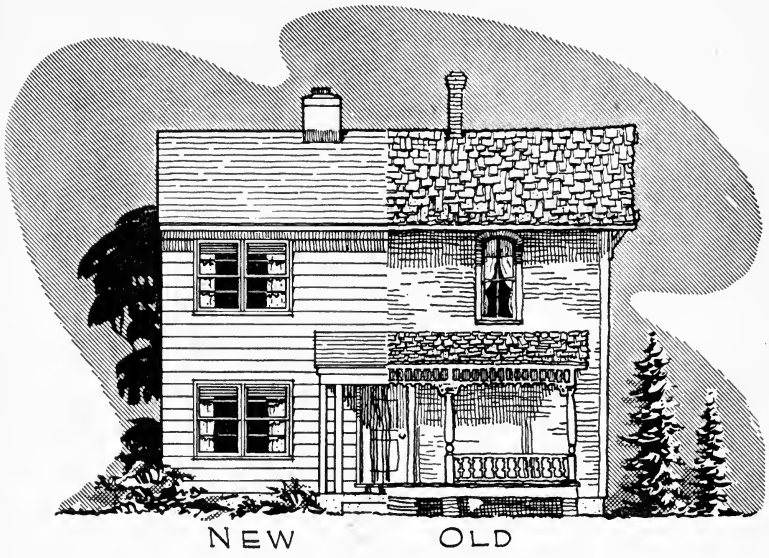


Figure 84. Characteristic remodeling for exterior improvement.

be based on complete information about the house to be improved. Following are the items needed:

1. Exterior photographs; two or more taken from angles that show all sides of the house; or four pictures to show each end and each side.
2. A sketch of the ground area to show the position on the site and the location of streets, alleys, lot lines, and near-by buildings.
3. An outline plan showing outside measurements and position of corners, projections, porches, and openings.
4. A diagram or plan of each floor, including the basement. Make the plan to scale on cross-ruled or plain paper. Use $\frac{1}{4}'' = 1'-0''$, or a larger scale. Mark dimensions on the plan to show width and length of rooms; distances from corners to openings, across doors and windows and between them; and location of stairs, flues, and built-in equipment. Measure ceiling heights, stairs, hallways, and other items.
5. Descriptions covering the condition of materials, finishes, and parts.

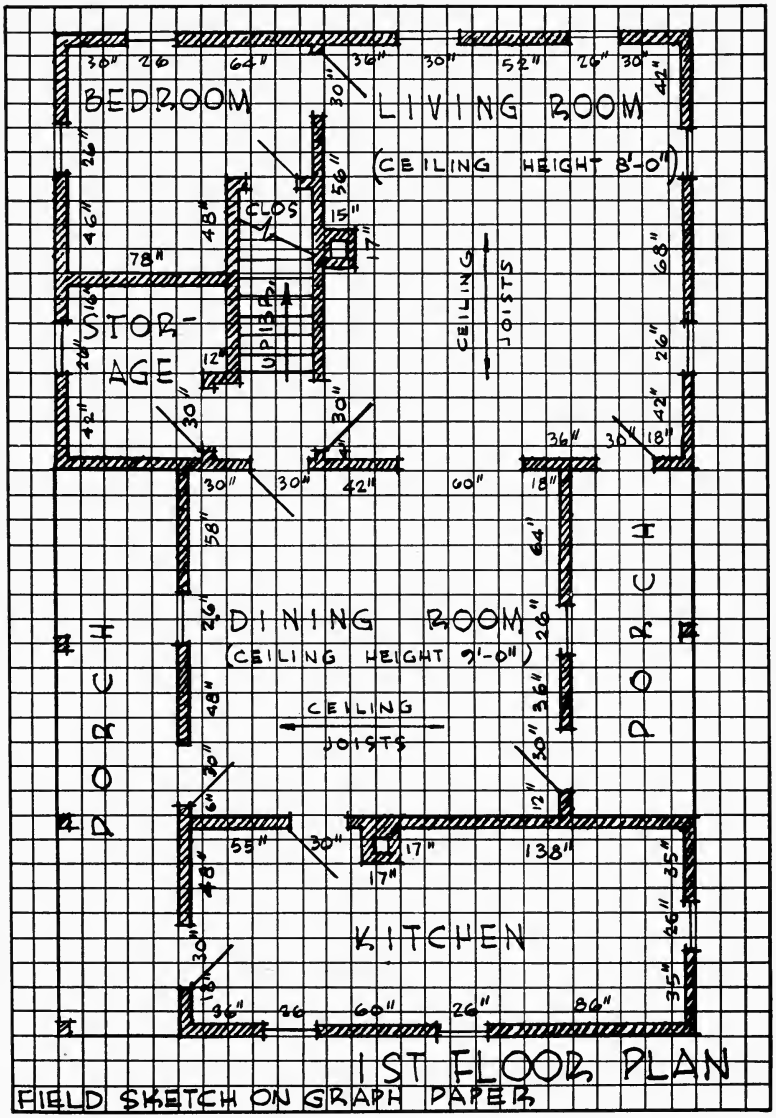


Figure 85. Sketch plan of existing house, with facts shown which are needed for remodeling study.

THE REMODELING PROGRAM

A remodeling program should be made by listing all proposed changes classified according to kind of work and the order to be followed. Plans of new houses suggest ideas that may be used in remodeling. Depending on the needs in each case, one or more of the following phases will be included in the program:

Figure 86. Remodeled exterior of square two-story house with one-story wing. See Figure 6 for original.

PLAN CHANGES. Among the common floor plan changes are: (1) changing the shape of rooms, (2) improving traffic lines and the relationship of rooms, (3) adding closets and storage space, (4) increasing the size of small rooms, or making two rooms from a large one, (5) finding space for bathroom, lavatory, laundry, or workroom, (6) rearranging the kitchen, and (7) enclosing porches or finishing attic or basement. Most changes in plan are made by relocating doors and windows, removing or adding partitions, modifying rooms for other purposes, or using space from a large room for closets or bathroom.

ADDITIONS. Careful planning will fit extensions and additions to the old part to make a unified plan. The simplest way to add

space is to enclose a porch. Sometimes attics can be finished as bedrooms or play space, but they may require dormers or stronger floor frames. Wings, ells, or extensions provide new units, such

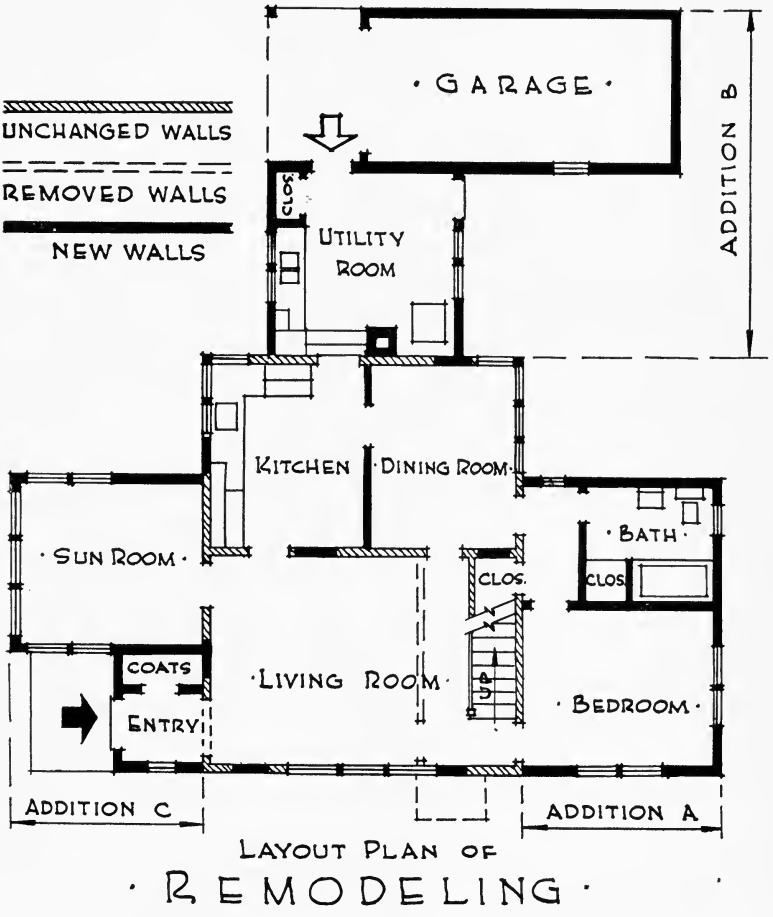


Figure 87. Remodeling study, showing indicated changes and additions.

as living room, kitchen, and workroom, or bedrooms and bath. Reductions. Occasionally a section or wing can be removed. If the house is in good repair, it is usually better to use extra space for recreation room, storeroom, laundry, or shop, rather

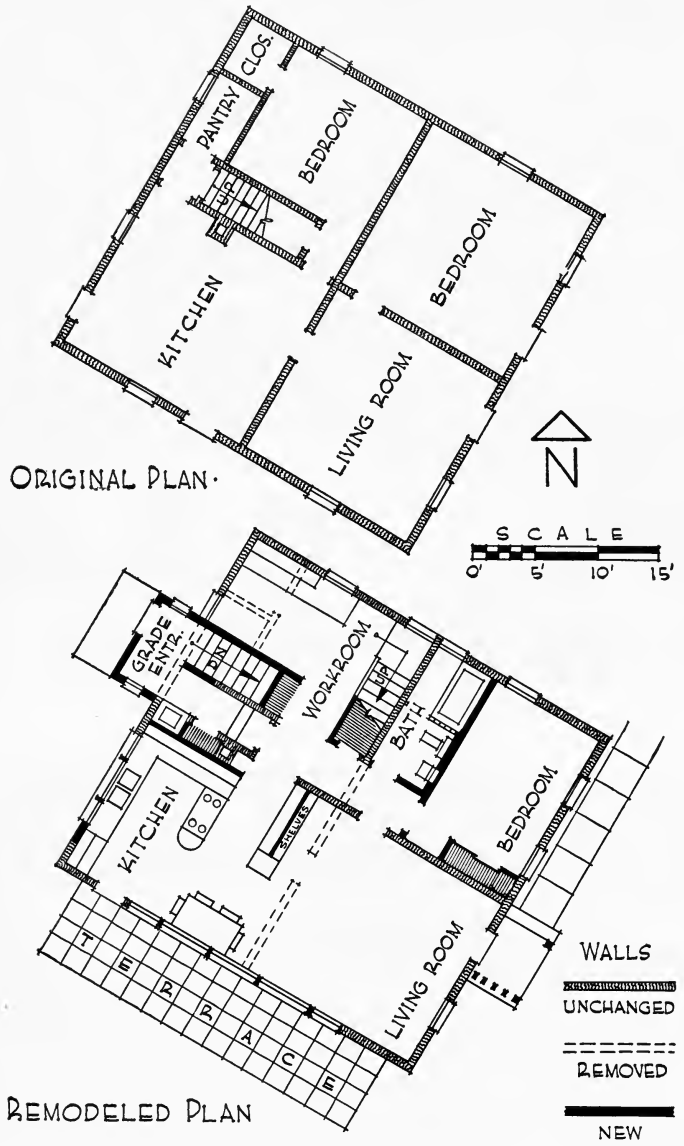


Figure 88. Before and after remodeling of first floor of an old house to add modern features.

than to destroy a good structure. Sometimes the best solution would be to convert part of the house into an apartment.

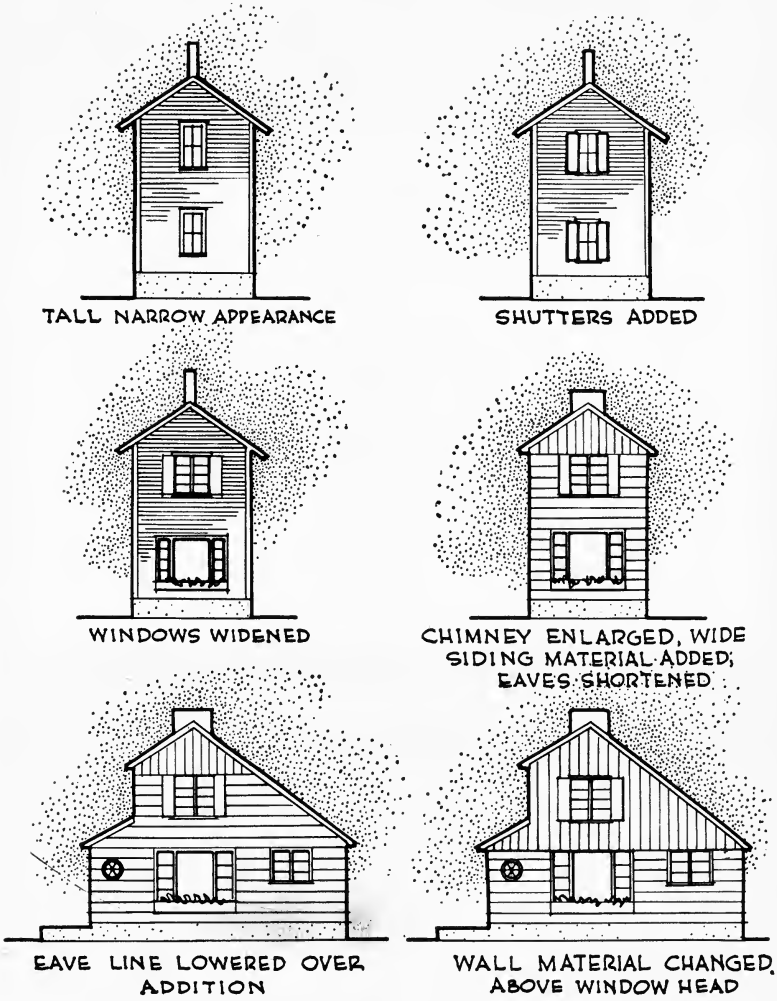

TALL NARROW APPEARANCE
SHUTTERS ADDED
WINDOWS WIDENED
CHIMNEY ENLARGED, WIDE SIDING MATERIAL ADDED; EAVES SHORTENED
EAVE LINE LOWERED OVER ADDITION
WALL MATERIAL CHANGED ABOVE WINDOW HEAD

Figure 89. Effect of changes on exterior appearance.

Repairs. Extensive remodeling almost always involves repairing at the same time. The principal needs are to: (1) replace sills, (2) strengthen framework, (3) rebuild chimneys, (4) patch

plaster, and (5) replace decayed or broken steps, porch floors, siding, and roofing.

STRUCTURAL CHANGES. Changing walls, floors, frame, and roofs should be kept to the minimum because of the expense and difficulty involved. Outside walls should not be moved, as this affects the framework and might seriously weaken the house. Instead,

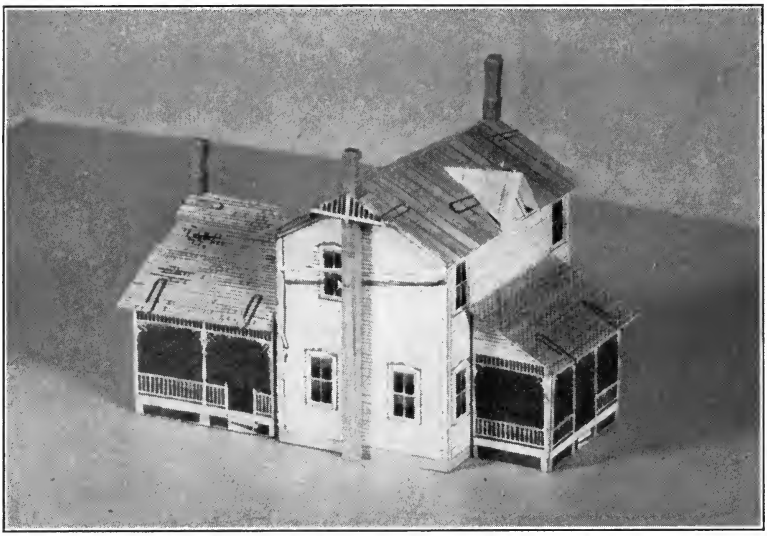


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Figure 90. Cardboard model T-shaped house before remodeling.

a wide arched or trussed opening may be cut in the wall to connect old and new parts.

Bearing walls, or inside walls that support framework and floors or walls above cannot be removed, unless beams, trusses, or other supports are used to replace them. Such walls generally set crosswise to floor framework. Many partitions (parallel with floor or ceiling joists) simply divide rooms, and are not needed for support. They can be moved or taken out. New partitions can be built as needed in the remodeled plan. Openings may be closed, and new ones cut for doors or windows. Stairs may have to be rebuilt for greater comfort, convenience, and safety.

To get a basement under an old house it is necessary to "offset"

the basement wall to form a ledge which stabilizes the foundation. Posts and chimney footings should not be disturbed. Since heating systems, laundry, and workrooms can be installed at ground level, it may be best to omit the basement.

Utilities. Equipment and appliances can be installed as satisfactorily in remodeled houses as in new ones. Electricians can "fish" wires through walls and floors. Pipes, and ducts may be concealed in walls and floors or by means of offsets or "boxed in"

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Figure 91. Model showing additions and alterations of house illustrated in Figure 90.

sections. It may be necessary to strengthen floors to support the bathtub, build larger firesafe flues for the heater, and repair openings made when installing utilities.

Comfort. Comfort is gained by installing heating systems, insulating the house, and making walls, floors, and ceilings tight. Instead of using fill insulation in sidewalls, it is better in some cases to cover old siding with building paper and a new outside surface. If inside wall surfaces are in poor condition, they may be replaced or covered with a material having some insulating value. New flooring or linoleum can be laid over old floors. In northern areas, storm doors and windows add comfort; in any

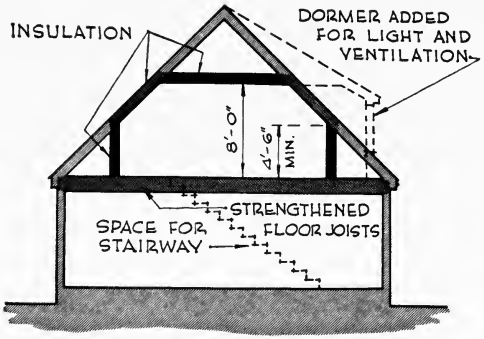


Figure 92. Common structural changes in remodeling.

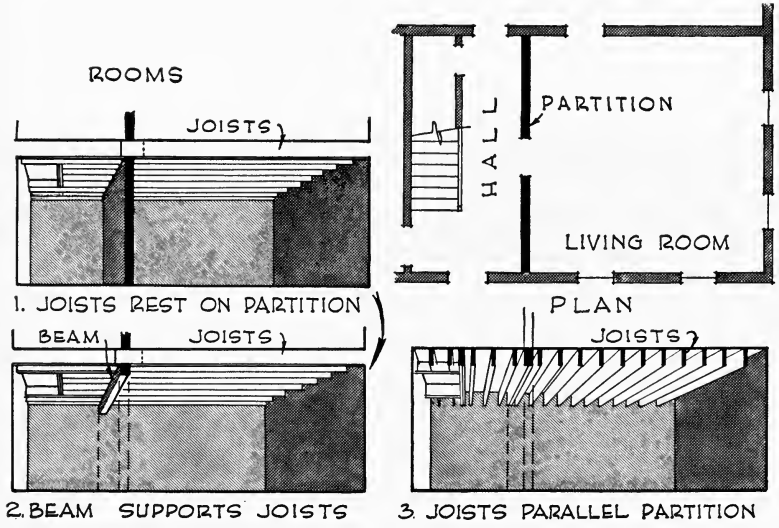


Figure 93. A partition that supports the structure overhead cannot be removed unless a beam is substituted to carry the joists.

area, weatherstripped openings are advisable to protect against cold, dust, and noise.

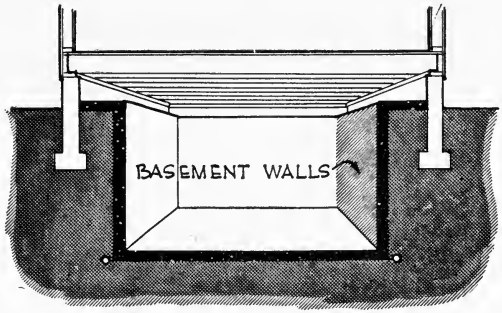


Figure 94. Walls are "set in" when putting basement under old house.

Finishes. Paint, wall finishes, floor sanding and finishing, reroofing, new siding, and interior wall paneling are common repair and remodeling practices. Alterations of eaves, porches, and windows supplement new surfaces to obtain new style effects.

CHAPTER 9

Farmhouses

About one fifth of all housing units in the United States are farmhouses. But such a large number, almost 6 million houses, cannot be fitted into one group or class for they may have little in common except their location on farms. Actually, differences among farmhouses are far greater than the difference between a farmhouse and a town house of a given standard of quality.

Housing requirements for family living are much alike, regardless of whether or not the house is on a farm or in the city. The same standards and the same planning principles apply. It follows, therefore, that farmhouses are "different" only because modifications are needed to fit basic house plans to farm locations, farm home activities, and influences that do not apply to nonfarm houses. Location, farming system, income and tenure affect what is done in each case.

WHY FARMHOUSE REQUIREMENTS VARY

Instead of representing a single "type," farmhouses must be adapted to a variety of conditions that cover fully as wide a range as urban houses. The principal factors are:

LOCALITY. Within the United States the climatic range is from nearly subtropical in the South, to long cold winters, high winds, and heavy snow in some Northern areas. The climate not only modifies the house plan, but also affects the selection of materials, amount of weather protection, and total cost. Of still greater importance, climate and soil determine the type of farming, which in turn influences the housing needs.

SYSTEM OF FARMING. On many farms, only one or two crops are produced, operations may be seasonal, and no attention is given to poultry, dairy stock, or meat animals which must be

watched and tended day by day. Examples are farms specializing in cotton, tobacco, fruit, wheat, and vegetable crops. Then the housing requirements are only slightly affected by the farming operations; urban house plans may be sufficient. The majority of farms are more diversified, producing poultry and dairy prod-

U. S. Gypsum Co.

Figure 95. A small midwest farmhouse.

ucts, cattle, hogs, grain, and hay. Close attention must be given to the farm work, and the operator must live near by. The farmhouse then becomes an integral part of the farmstead and the "unique features" of farmhouses are important planning factors.

Resources. Poor markets, small acreage, low productivity, and eroded or wornout land often limits farmers' earning capacity. Ideal housing cannot be afforded, and it may be necessary to limit the size and convenience of the house to less than what the

family wants and needs. Productive farms with high potential earning capacity can support excellent homes.

TENURE. Only about one half of the farms in the United States are occupied by their owners. The rest are operated by renters, tenants, managers, or hired workers who may be attracted by the

Coke Heller and the U. S. Gypsum Co.

Figure 96. High-quality modern stone-veneered farmhouse.

farming opportunity rather than by the quality of housing. Generally, tenant-occupied farmhouses are somewhat poorer than owner's houses. Good housing helps to attract good tenants, but is not the most important factor in choosing a farm. Farms operated by the owner may be mortgaged, and savings must be used to pay debts rather than to improve homes.

To an increasing extent, urban people are buying or building in rural areas within driving distance of their work. Some do part-time farming, others maintain only small acreages, or hire their farm work done. Housing in such cases, as in small towns

and villages, is not "farm" housing in the strictest sense, although some rural problems are involved in obtaining utilities and in fitting the house to the surroundings.

In the Census and other statistical reports, housing is classed as "urban" or "rural." "Rural" includes farm housing and housing in small communities, towns, and villages up to 2,500 population which is called "nonfarm rural."

COMPARING URBAN AND FARM HOUSES

The points of difference between urban and farm housing are mostly in the factors, conditions, or circumstances that influence what is done. These differences are illustrated by the following comparisons:

In urban housing	*In farm housing*
1. Usually the house is separate from the business or employment. The family can buy, sell, or rent.	1. The house is part of the farm. The farmer must live near his work, and, regardless of individual needs, he must live in the house provided.
2. A house is selected for its quality, location, and cost.	2. Farmers must weigh productivity of the land, size of farm, or fitness for profitable farming; the house is secondary.
3. Cost is paid from relatively fixed wages, salary, or business income. If financial reverses come, the family can move to another house within the area.	3. House costs must be paid from farm income; if income drops, the house may be neglected to meet current expense; bad housing is associated with low-income farming.
4. Financing is relatively easy. The house has a substantial value as security, monthly payments can be required, and financing agencies can maintain supervision; FHA-insured and Building and Loan Association loans are the most common.	4. Financing the house may obligate the whole farm for mortgage security, since the house has little value apart from the farm. Payments must be made from farm income which is often irregular. Few farmhouse loans are made by Building and Loan Associations or FHA-supervised lenders.
5. Many building services are available, including architects, contractors, and skilled workmen. Housing is built more efficiently in large-scale operations.	5. Architects do not generally design farmhouses. Fewer contractors and skilled workmen are available. Transportation costs are increased both for materials and workers. It is more difficult to use modern efficiency methods.

6. Housing is regulated, controlled, and protected by zoning, codes, permits, inspections, restrictions, and fire protection.	6. Few regulations or none at all apply. The usual enforceable safeguards are those which may be demanded by power companies for electric service, by insurance companies to meet policy requirements, or by lenders to protect loans.
7. Public utilities or services provide water supply, sewage disposal, gas, electricity, storm drains, sidewalks, paving, and fire protection.	7. One-half or more of all farms in the United States had power-line electricity in 1948. Farmers must provide or arrange for other services such as water supply, pumping system, septic tank disposal, and liquid petroleum gas.
8. Higher land costs, higher taxes, special assessments, small space, and lack of control over surroundings are disadvantages. Building practices usually prevent owners from making their own improvements.	8. Lower land cost, lower property taxes, generous building site, possibilities for landscaping, and control of surroundings are advantages. Tools, equipment, and free time part of the year enable farmers to make some of their own improvements.

A serious situation occurs in some areas that are neither farm nor urban, usually where building developments occur outside city limits in heavily populated communities. In such places the community lacks the protections, controls, safeguards, and some urban services, while the values of a "farm" setting are lost because of small acreages. Much concern has been indicated by housing interests over fire and health hazards and possible deterioration in standards. One proposed solution is to establish county- or state-wide regulations. County codes have been established recently in a few places; their value has not yet been proved.

POINTS OF SIMILARITY

Differences in planning needs between farm and town houses are due to the necessity of fitting houses to conditions and needs. In many ways, the requirements are similar, and procedures used in developing a farmhouse plan may be about the same as for any other plan. The principal similarities are found in: (1) facilities for food preparation, eating, family living, sleep, and rest, (2) basic pattern of arrangement of house parts, except as modi-

fied to the farmstead setting, (3) standards of quality, (4) use of materials, and (5) house size and style.

SPECIAL FARMHOUSE PLAN FEATURES

The important point in farmhouse planning is to fit the plan to farm family living needs and farm patterns of activity. These fac-

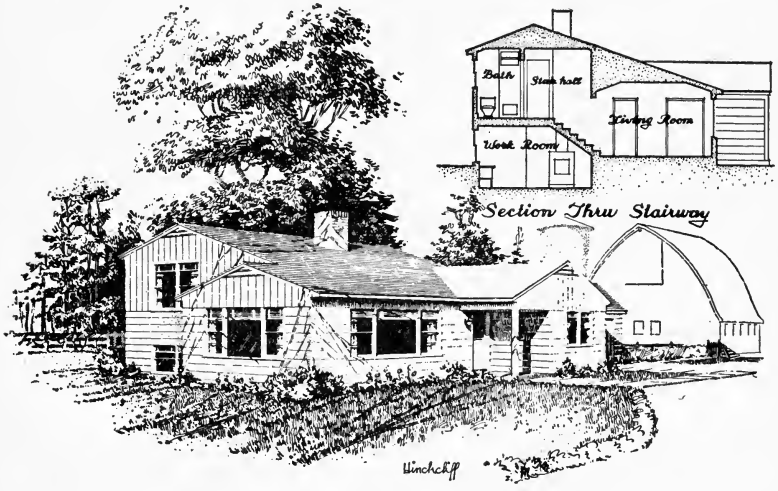
Figure 97. Important considerations in farmhouse planning.

tors, although few in number are especially important in obtaining the most suitable functional plans.

Access from the driveway. Visitors and members of the family come to the house from the driveway rather than from the public road. It is most convenient to have the main entrance to the house

on the driveway side rather than facing the highway. The plan should provide for parking cars, access for delivering fuel and supplies and for reaching the work area of the house.

Service entrance. The kitchen entrance should be accessible to the driveway and the farmyard. The arrangement of hallways or doors should be planned so that basement stairs, washup space,



Carter-Hinchcliff in Capper's Farmer

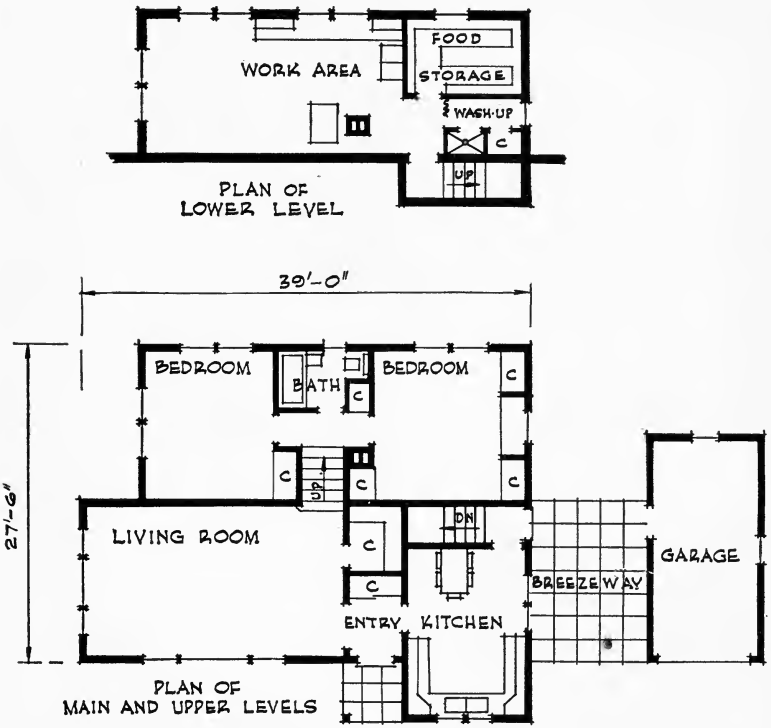
Figure 98. Perspective and section of a "3-level" farmhouse.

workroom, and kitchen are easily reached without interrupting kitchen work. On the farm, people go in and out of the house many times each day. Women often attend to the garden and poultry and sometimes assist with farm work. One half or more of the farmer's work time is spent at the farmstead near the house. Work is irregular and during the winter farm workers may be indoors much of the time.

Washup space. Workers coming directly to the house from barns or fields need a place to change work clothes, store their wraps, boots and shoes, and bathe or wash before meals. The house plan should include a small room, or space in the workroom for storage and a washbowl. A toilet and shower makes the arrangement more convenient and complete.

Workroom. Laundering, food processing and preservation, cooking for large groups, and preparing food products for sale are

common farm home activities. Cleaning dairy utensils, dressing poultry, and butchering are heavy-duty jobs requiring hot water, special equipment and storage space. The best arrangement to meet these needs is a workroom planned as a part of the work



Carter-Hinchcliff in Capper's Farmer

Figure 99. Floor plan of 3-level farmhouse shown in Figure 98.

area. It may be in the basement or at the ground level, but preferably on the first floor near the kitchen.

Large kitchen. The farm kitchen often serves as a center of family activities. Cabinets, equipment, and work space should be arranged in a compact group uninterrupted by traffic lines or doorways. A relatively large range and refrigerator are needed for home food preparation. In addition, the kitchen must often serve for ironing, mending, and sewing, and as a play space for children. Farmers do "chore work" before breakfast and after

the evening meal; noon meals must often be hurried; and in busy seasons the men may work until dark. For these reasons space should usually be provided for eating in the kitchen.

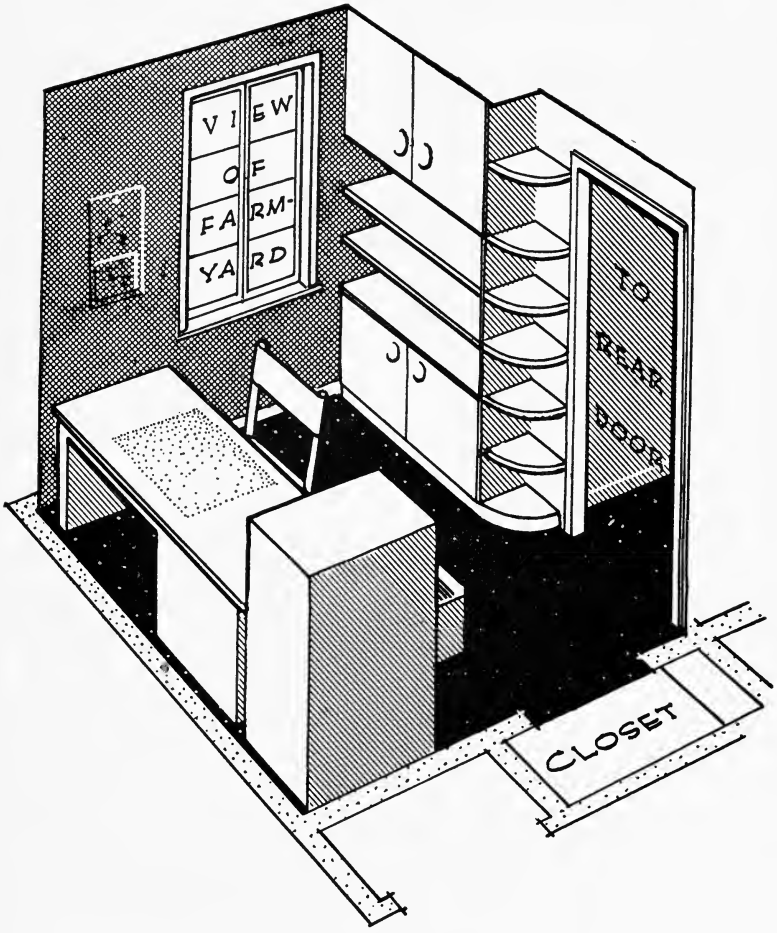


Figure 100. Suggestions for small office in the farmhouse.

Business center. Office space is needed for farm records, reports, and transactions. The office should be planned either as a separate room, or combined with dining room, study, or another room. Other farm influences. The farmhouse plan should be highly

flexible to accommodate a variety of needs. Consideration might well be given to one or more "all-purpose" rooms, readily adapted for sleeping, study, sewing, or business activities. If hired workers are to live in the house, more bedrooms will be needed. A combination garage and workroom near the house might be suitable on some farms. Basement rooms may be utilized for drying clothes, and for workrooms, shop, or recreation space. Large attics can often be insulated and finished for part-time occupancy when needed.

Univ. of Illinois Small Homes Council

Figure 101. Exterior perspective farmhouse design in modular construction. See plan, Figure 102.

Utilities. Farm utilities differ somewhat from urban facilities. The farmer must consider these differences in his improvement program, although the house plan itself is not affected. If power-line electricity is not available, small gasoline-powered electric generators may be used. Wind-power generators operate radios, recharge storage batteries, and light a few lamps. Liquid petroleum gas in iron cylinders or tanks can be used for the operation of furnaces, ranges, water heaters, and refrigerators. Cooking, heating, and water-heating equipment is available for use with fuel oil. Various supply systems, preferably electric, are used to obtain water. Pumps should have a capacity of 300 to 500 gallons an hour. The septic tank is the most satisfactory sewage disposal method. Rural fire protection is limited to chemical extinguishers except in a few communities that have rural fire departments or working

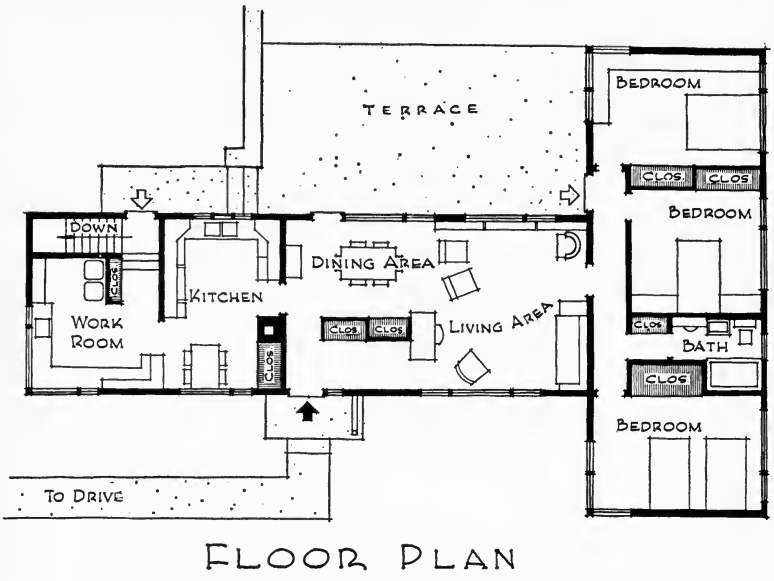


Figure 102. Sketch plan of basic farmhouse also illustrated as a "working drawing" in Figures 16 and 17. Plan is adaptable for different facings on a public road.

agreements between near-by municipal departments and insurance companies.

LOCATING THE FARMHOUSE

The farmhouse is a part of the farmstead group. Usually it is the building nearest the public road. It should set back 100 feet or more to avoid highway dust, odor, and noise. If set back more than 150 or 200 feet, it is difficult to maintain a finished lawn in front, driveway construction is increased, and power and telephone lines are more expensive. The house should be located on relatively high ground for good drainage. Plantings may be used to screen the view of the farm buildings but not cut off the view entirely. Odors may be minimized by avoiding barn and feed-lot locations in the direction of prevailing summer wind. In most places windbreak protection from winter wind is also desirable. With ample ground area available, planning should take account of driveway location, parking space, clothes drying yard, and outdoor living space.

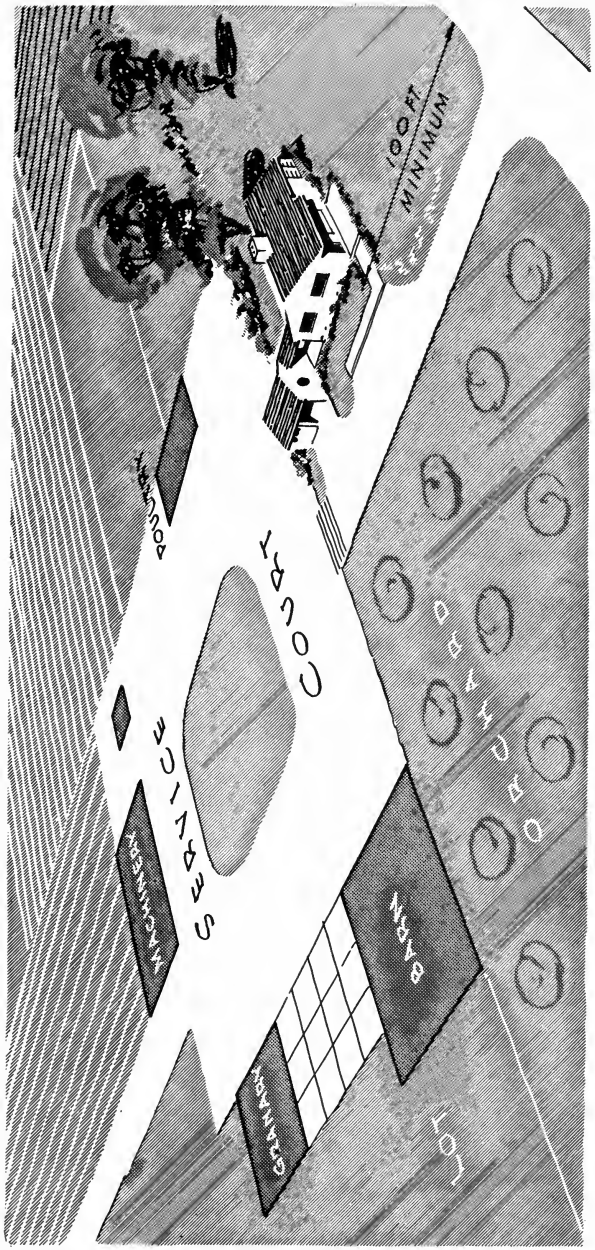


Figure 103. Plot layout of farmstead showing relation of house to the farm buildings.

FARMHOUSE PLANNING SERVICES

Many planning helps are available to farm families through the medium of the state extension services and the U. S. Department of Agriculture. Because architects' personal services are not generally available to farmers, these public aids are widely used. Educational services include local assistance from county agents and home demonstration agents, and meetings and demonstrations by specialists. Bulletins, circulars, and leaflets are available without cost, and most state colleges supply blueprinted house plans at nominal cost. Other farmhouse planning helps are supplied by farm magazines, lumber dealers, trade associations, and manufacturers of materials and equipment.

CHAPTER 10

Planning Home Equipment

Today's home should have electricity, plumbing, and central heating, as a matter of course. But the kind and quality of equipment selected are important in getting such values as health, comfort, convenience, and satisfaction. The house must also be planned in its details of arrangement and construction to accommodate the equipment to the best advantage.

Water supply, sewage disposal, electricity, gas, and telephone are essential to the modern house. These are the "utilities," generally supplied by municipal, co-operative, or public service companies. They are provided by the home owner only in cases where they are not otherwise available, as on farms and in villages or suburban communities. The utilities themselves do not affect the house plan.

Appliances are sometimes installed as permanent units of the house. Then the range, refrigerator, water softener, dishwasher, and garbage disposal unit are fitted to the house, both in quality and size and space requirements. The appliances chosen may have some effect on the house plan. For example, a larger kitchen is needed for a wood or coal range than for a gas or electric range, and a chimney must be provided. Dishwasher-sink combinations require more floor and wall space than an ordinary cabinet sink.

The electric wiring, plumbing, and heating systems are integral parts of the house, ordinarily put in when the house is built or when extensive remodeling is done. Electric outlets must be located, flues planned for the furnace, registers or radiators located not only for efficient heating but also to conserve wall space for furniture, and locations planned for bathroom and plumbing fixtures in a way to assure a convenient arrangement.

Mechanical equipment requires special skills for installation, and

so the work is normally done by contractors or specially trained workmen. It is usually necessary to look to architects or engineers for responsible service in designing and specifying installations. Reliable stores and contracting companies have enough information and experience to recommend the correct types and sizes. Public utility companies are willing to advise customers and help in planning electric wiring and lighting.

The owner's problem is to choose from among available selections to get the best values appropriate to his particular needs. Colors, models, and styles are matters of personal choice. It is more important to be sure the equipment is safe and suitable, that codes and regulations are followed, and that the installations have the capacity, size, automatic controls, or other features to give the kind of service and convenience desired. These points are outlined in the following discussion.

PLANNING ELECTRIC SERVICE

As new home appliances and devices are developed, present wiring may become inadequate to carry the electric load. Although no. 14, or 14-gage wire is generally permitted by codes, heavier no. 12 wire is better because it will carry more current. Some authorities recommend no. 10 wire which gives still more capacity. Number 6 wire is required for electric ranges and water heaters.

CIRCUITS. Each house should have several branch circuits or lines of wiring from the meter. One each is needed for electric ranges and water heaters. It is well to have one circuit for the refrigerator or home freezer; at the most only a few lights or appliances should be connected to this branch. At least two branches are needed, even in houses with only three or four rooms. Most houses should have four to six branch circuits to avoid danger of overloading. The load on the different circuits can be "balanced," for example, by connecting outlets in the kitchen and one bedroom to one branch; living room and laundry, or hallways and dining room connections may be on separate branch circuits. In this way, only a few lights or appliances will be in use at a given time on any one circuit. If an overload or a "short circuit" puts one branch out of order, the others are not affected.

WIRING. The wiring system consists of: (1) a meter, supplied by the power company, (2) a main "lead-in" to the load center

or point where the branch circuits start, (3) a main switch and fuses to protect the house wires, (4) a distribution panel with fuses or circuit breakers for each branch, and (5) branch wiring with its separate pairs of wires, switches, connections for fixtures, and convenience outlets.

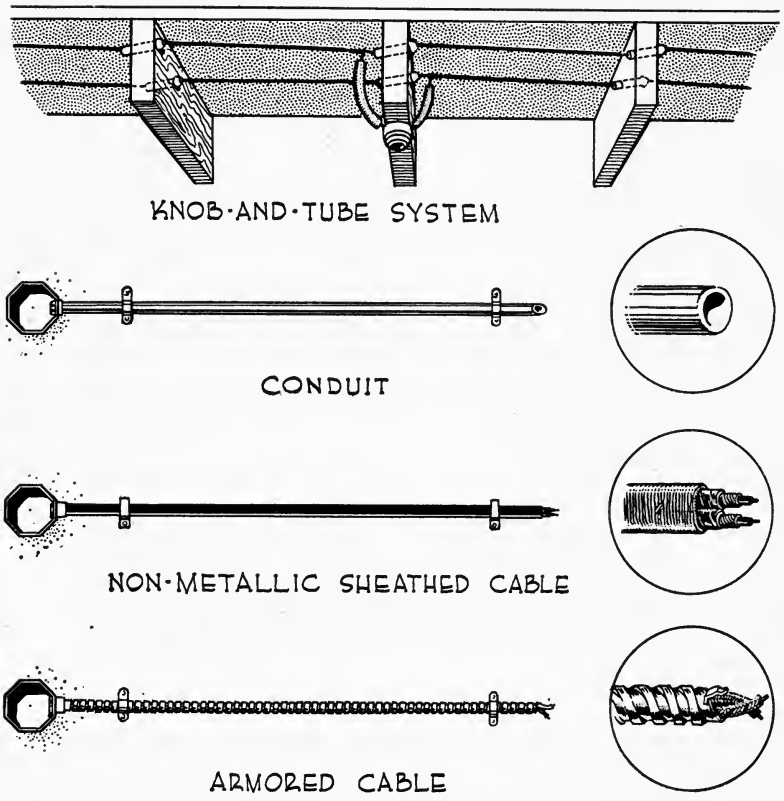


Figure 104. Common types of wiring for residential use.

All wiring and parts should be standard items, which carry a label showing their approval by the National Board of Fire Underwriters. As a further safety measure, wiring contracts should specify that the work be done according to the National Electric Code. Licensed electricians should be employed to do the wiring, and all work should be approved by a qualified inspector. Power

companies and contractors know the codes and requirements; the owner should insist that all regulations be observed.

Types of wiring. Four types of wiring systems are used: *Knob and tube* consists of two separate covered wires forming each

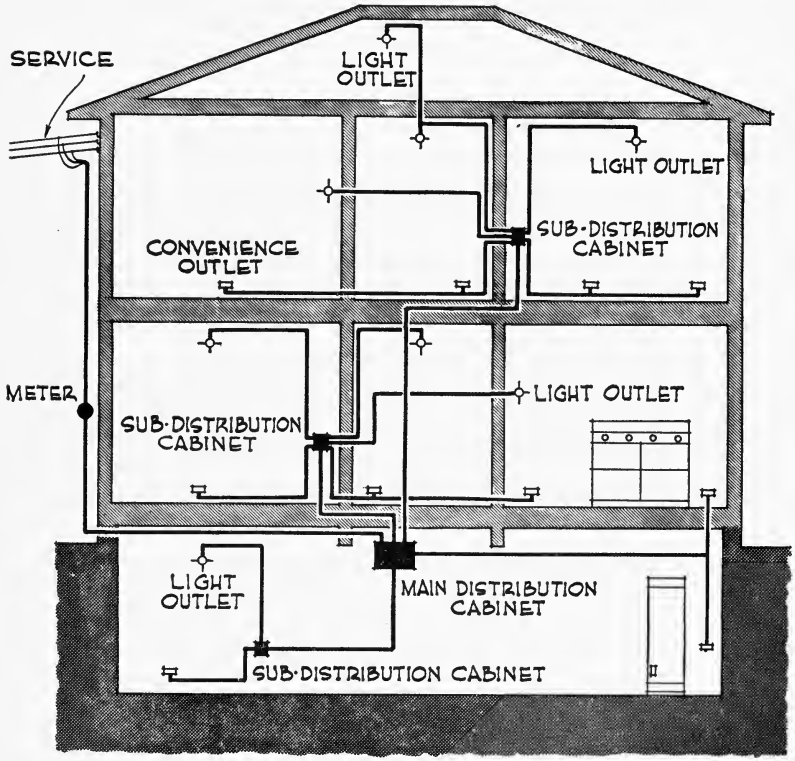


Figure 105. Diagram of electric wiring system (not a wiring plan) as recommended for adequate service.

circuit. Wires are insulated from the structure by porcelain knobs and porcelain tubes. This type is most common in old houses and is usually the least expensive wiring. *Nonmetallic sheathed cable* is a single insulated flexible sheath containing two or more wires separately insulated. The cable may be stapled to wood parts or drawn through structural parts. This type is the most widely used. *Armored cable* has wires encased in a flexible metal

sheath and is installed in much the same way as the nonmetallic type. *Conduit* is metal pipe that completely encloses the wires. It is the most expensive of any of the types.

WIRING PLANS. Meter, lead-in wires, master switch, distribution panel, and subpanels should be located with the advice of the architect or a power company representative. The electrician decides how the wires are to be placed for best economy and proper arrangement.

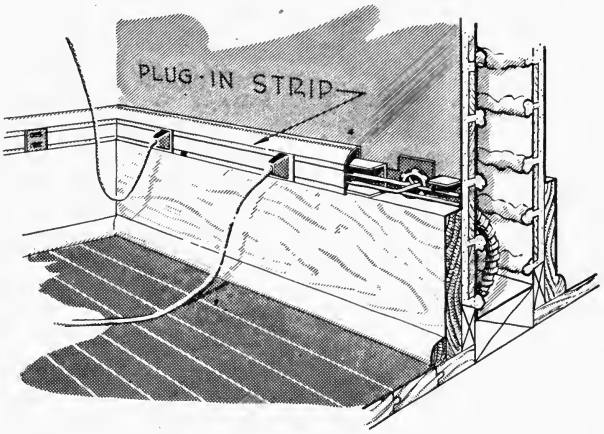


Figure 106. Plug-in strip may be used instead of individual convenience outlets.

The owner decides on the number of circuits, wire sizes, type of wiring, number of "openings," and kind of fixtures. The plan should show the location of each *opening* or point where wires are to be connected to switches, fixtures, or convenience outlets. The openings may be shown on the original plan of the house, marked on the blueprints, or indicated on a separate sketch.

In planning, provision should be made for the following: (1) A light in each room, and areas such as attic, basement, hall, stairway, porch and garage, (2) a light in each principal closet, (3) a bracket light on each side of bathroom mirror and above the sink and the range in the kitchen, (4) a wall switch near the entrance to each room, pull-chain switches in closets and little-used spaces; and multiple-switch sets in large rooms, long

halls, and stairways, and (5) duplex outlets for plug-in connections; at least two in each room, or more if needed, to connect appliances along each wall space, without using cords more than 6 feet long. The kitchen and living room may need four to six duplex outlets for the many appliances, or plug-in strips may be installed to permit connections every 12 to 24 inches along the wall.

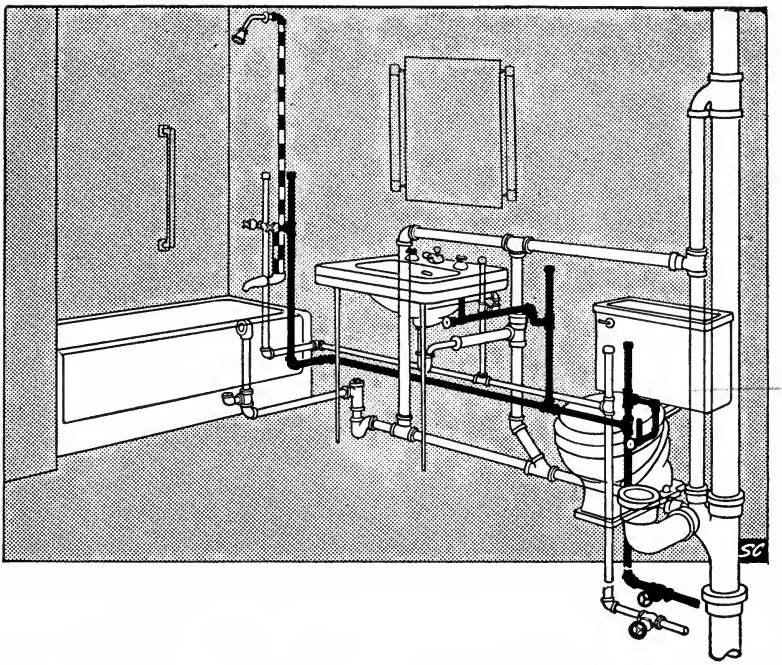
FACILITIES FOR HYGIENE

Some economy is gained in plumbing by planning the sink, laundry tubs, and bathroom fixtures in a compact area in one part of the house. For example, in a two-story house, the basement laundry, first-floor kitchen, and upstairs bath might be placed one above another. In prefabricated houses, the principal fixtures often are located on adjacent walls, or around a shell or shaft that contains the wires, pipes, and connections. Although savings should be made where possible, the convenience of the house is more important than cutting down on pipes and fittings.

WATER SUPPLY. Hot and cold running water is needed in the kitchen, bathroom, lavatory, and workroom or laundry. About 40 gallons per day is needed for each person. Water is distributed through ½-inch or ¾-inch galvanized pipe or copper tubing of equal capacity. Pipes are placed under floors and in walls; outside wall spaces containing pipes should be heavily insulated to prevent freezing.

Equipment should include a hot-water heater and storage tank. Automatic gas, oil, or electric water heaters are the most desirable. Hot-water tanks may be connected to the furnace, kitchen range, or a separate heater. Tanks should have a minimum capacity of 30 gallons; a 50-gallon tank is better. A water softener, especially in the hot-water line, is desirable in localities where the water is hard.

PLUMBING. Minimum fixtures generally include bathtub, toilet, lavatory, and kitchen sink. More complete plans include shower, laundry tubs, a sink in the workroom, and fixtures for two or more bathrooms, or lavatory rooms. The stack, or soil and vent pipe, extends vertically from below the ground to a point above the roof. It carries waste from all fixtures, and provides an air vent, which is necessary for the operation of drain traps. The water closet must be located within 2 or 3 feet of the stack. The



Plumbing and Heating Industries Bureau

Figure 107. "Phantom" view of supply and waste piping for bathroom.

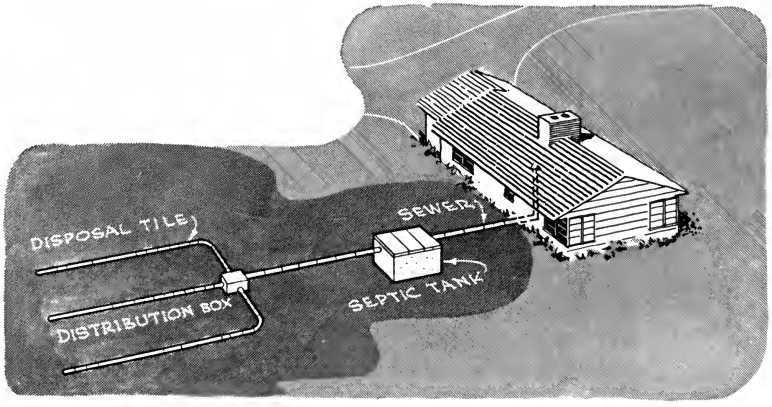


Figure 108. Elements of septic tank sewage disposal system.

stack may be concealed in an 8-inch wall, or the wall may be enlarged for a distance, or a boxed-in enclosure may be used. Drain pipes must slope from the fixtures to the stack; drains should be accessible for cleaning through a cleanout plug. All fixtures must have a trap or water seal and be "back-vented" with an air pipe from the trap to the upper part of the stack.

SEWAGE DISPOSAL. If a sewer line is accessible, it is necessary only to arrange for the connection and provide a 5- or 6-inch house sewer line from the house to the main line. Otherwise a septic tank system is recommended. It consists of an underground container, holding at least 500 gallons (for a family of not more than 7 persons). Either cast-in-place concrete or prefabricated tanks may be used. A subsurface line or lines of drain tile receives the overflow from the tank.

HOUSE HEATING

Central systems are preferred for house heating. Compared to stove or space heaters, central heating is more uniform, automatic controls may be used, and the heater can be installed in basement or utility room, away from the living area. Among the choices are: (1) warm air, steam, or hot water as the heating medium; (2) gravity circulation, or forced circulation by means of a fan or pump; (3) coal, coke, oil, or gas for fuel; and (4) various types of ducts, registers or radiators, automatic controls, and special features. Heating systems vary greatly in style, type, cost, and value, so that detailed information is needed before a choice can be made.

Each system should be selected according to the requirements of the house in which it is to be installed. For example, a coal-burning furnace usually requires more space than an oil or gas furnace with the same capacity. A coal bin should be provided to hold several tons of coal, preferably enough for a year's supply. Oil or gas heaters can be installed at the ground level or on the first floor—some new types for houses without basements can be set under the floor, in the attic, or in a small closet.

Forced circulation should be a part of the system unless the heater is located in the basement. If the house is large, or if it is long and low, forced air or forced hot water is preferable in any case.

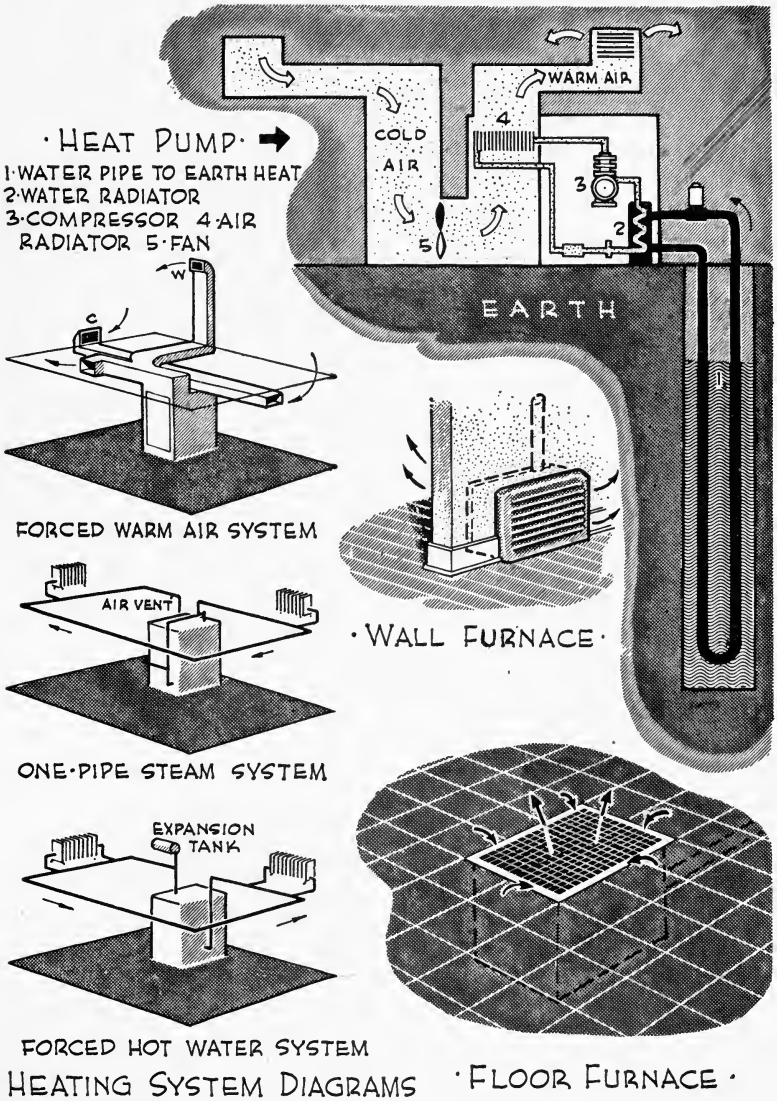


Figure 109. Basic types of house heating systems. Although the "heat pump" is in use, the system is not common.

Design of system. Heating equipment is selected according to the volume of the house, the amount of exposed wall area, space occupied by doors and windows, and the winter climate in the

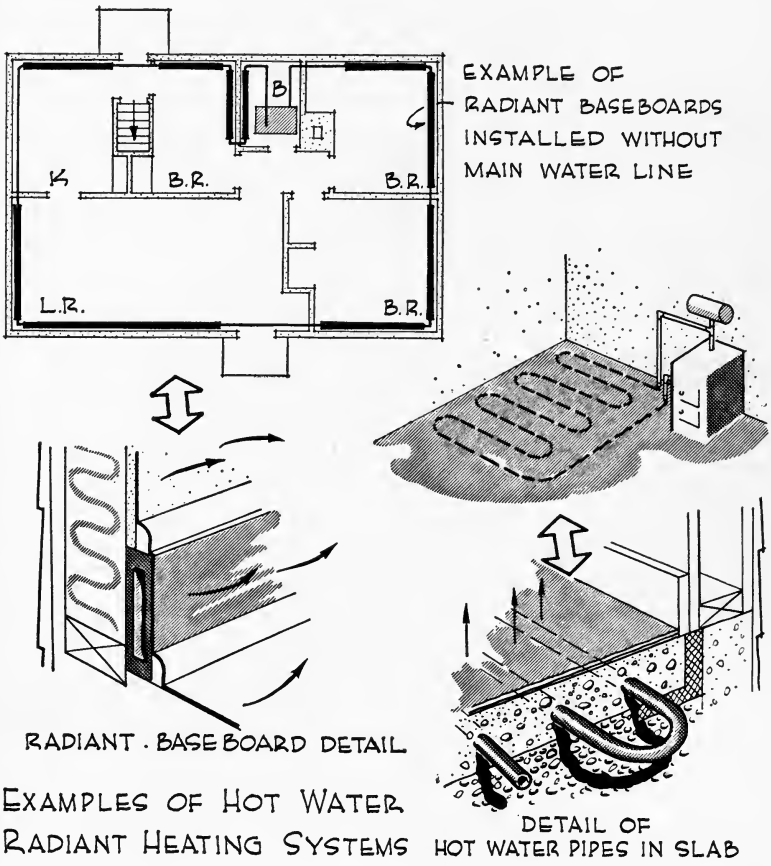


Figure 110. Radiant baseboards directly replace other common radiators in hot water systems. Radiant or panel heating supplies heat to the room by radiation and, to some extent, by convection.

locality. Engineers and contractors use proved data and formulas developed by research studies. The data are applied to each house to determine requirements. The system should be guaranteed to have the proper capacity when installed and operated according to manufacturer's directions.

New trends in house planning, heating research, and equipment design will likely affect future planning. For example, large areas of double-glass windows are used in the south wall for "solar" heating. The windows provide enough warmth on sunny days in winter to reduce materially the artificial heat needed. Thus, a smaller heating system might be used and fuel costs reduced.

Ingersoll-Rand

Figure 111. Model display of house equipped with prefabricated heating and utility unit (upper left).

Another development is based on the fact that warm surfaces radiate heat. Heating elements in panels in floors, walls, or ceilings may be used for heating and thereby eliminate exposed registers and heavy radiators. "Panel heating" or radiant heating appeals to many home owners. Another very old principle of the "heat pump," which absorbs heat from the earth, is used experimentally. Tests of these newer methods under a wide range of conditions will be necessary to determine their value for the average home.

AIR CONDITIONING. At present air conditioning has only limited use in typical houses. Several elements of air conditioning systems are available in modern heating equipment however, for the air is warmed, humidified, circulated, and filtered. Artificial cooling is not generally used; or its use is limited to one room in the house. Better comfort can often be obtained by using electric fans and exhaust fans in the kitchen and attic.

CHAPTER 11

Protective Qualities

Hazards to life and property may occur in the home unless precautions are taken to assure safety and protection. Even with good planning, there is always danger that poor materials or workmanship or undue cheapening may create hazards. Accidents, fires, decay of the structure, and personal discomfort can be prevented by making certain that equipment is properly installed, construction is sound and durable, and plans are checked to eliminate dangerous conditions. The principal requirements are (1) to prevent accidents, (2) to provide safeguards to health, (3) to assure comfortable conditions, (4) to make the house fire-safe, and (5) to control moisture.

ACCIDENT PREVENTION

Every year 30,000 people lose their lives in home accidents, and a million are injured. Thus, in terms of numbers of accidents the home is one of the most dangerous places. Falls and burns are responsible for more accidents than all other causes. Good construction provides safeguards against falls and burns, as well as other hazards including electric shock, cuts, and bruises. A house will be reasonably safe if it is checked for hazards and if the precautions listed below are taken:

1. Build stairways with at least 6½ feet of headroom and according to standard proportions; make all steps uniform in size, height, and width; install handrail, avoid winding steps, and make all landings equal to the width of the stairs; protect outside steps from ice and snow, or provide a handrail.
2. Make floors at the same level throughout each story.

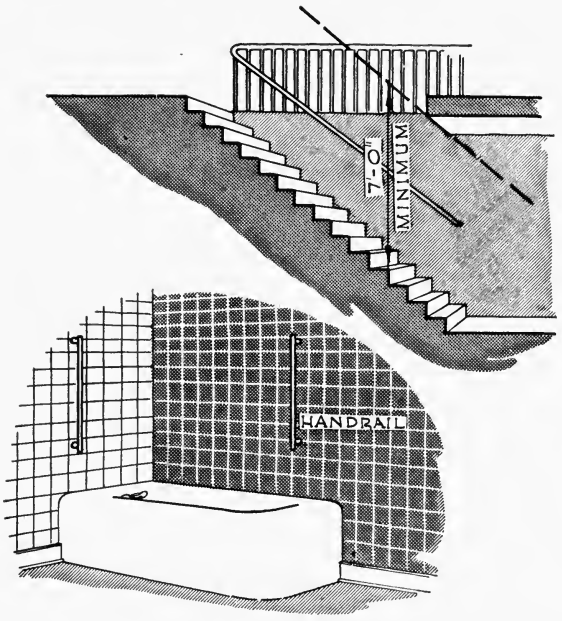


Figure 112. Falls account for more home accidents than result from any other hazard. Provide handrails and other safeguards.

3. Place railings around porches, balconies, and flat roof sections that are accessible from the house.

4. Install screens or storm sash on openable windows and guard rails on windows at stair landings or other hazardous locations.

5. Build hand grips solidly into bathroom wall above bathtub.

6. Place electric outlets and switches to avoid danger of touching both electric device and plumbing fixtures at the same time.

7. Install heating equipment, gas appliances, and electric wiring according to codes, using materials approved as adequate by National Board of Fire Underwriters. Have installation inspected and approved by qualified inspector.

8. Provide clearance of 2 or more inches between edge of doors when open and nearby furniture or equipment.

9. Place projections, such as hooks, nails, and shelf edges to prevent contact, particularly at eye level.

10. Keep house repaired to eliminate hazards such as loose plaster, splintered floors, decayed railings, broken steps, and loose boards.

11. Provide enough natural and artificial light for good visibility in each room, hallway, and stairway.

HEALTH SAFEGUARDS

Codes and regulations are made and enforced to protect health by requiring safe plumbing, sewage and garbage disposal, elimi-

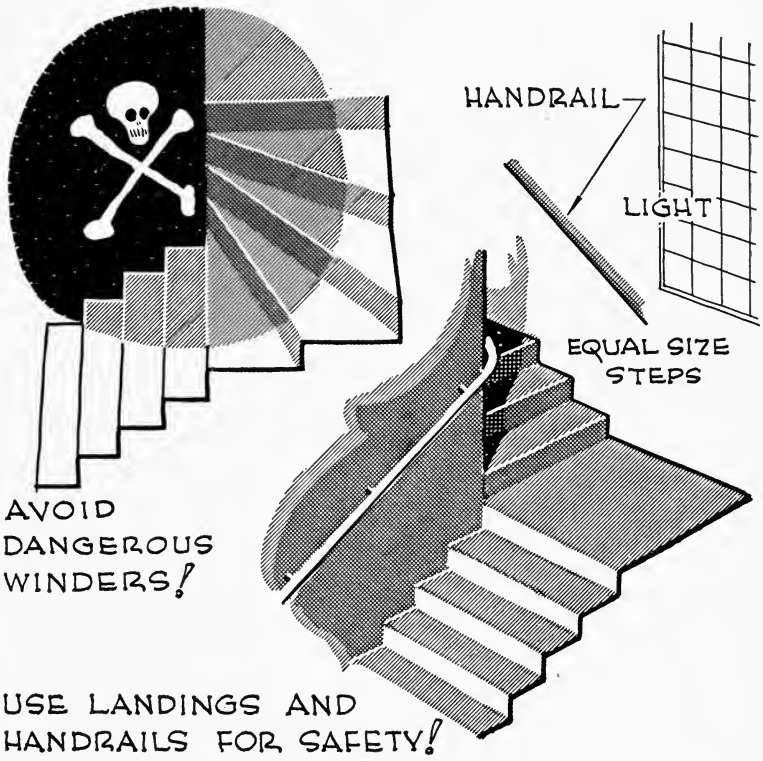


Figure 113. Provision for safe stairways.

nation of nuisances, and observance of building rules. Within the home, requirements are daylight and sunshine in living rooms, natural or forced-air circulation, and reasonable control of temperature. "Healthful housing" means protection against fire and accidents, provision for comfort, reduction of fatigue, and precaution against contagion. Detailed information is included in a report entitled "Healthful Housing" published by the committee

on the hygiene of housing of the American Public Health Association. It contains statements outlining 30 basic principles that should be observed in planning houses for maximum health values.

The owner is responsible for the following measures to eliminate hazards to health:

1. Obtain water supply from a tested protected uncontaminated source.
2. Provide for sanitary sewage disposal by connection to sewer system or septic tank.
3. Make houses tight enough to exclude rodents and vermin; provide for extermination when necessary.
4. Arrange artificial and natural light sufficient to prevent eyestrain; avoid glare.
5. Avoid construction having grooves, cracks, and rough surfaces, so as to permit easy cleaning.
6. Install heating system, insulation, summer cooling, and other comfort features.
7. Use protected containers for garbage and rubbish. Secure prompt removal and disposal.

COMFORT

To meet comfort standards, the house should be built to exclude dust and drafts and avoid extremes of heat and cold. Unless the house is insulated and made reasonably tight and the heating system has ample capacity, wide temperature differences occur in the various rooms. Air currents may be induced that cause discomfort. Air may become "stratified" with warm layers near the ceiling and cold air near the floor.

Generally the house should be kept at 65°F or warmer for normal vigorous adults; 75° may be required occasionally. Comfort is affected by air temperature, floor, wall and ceiling surface temperatures, air movement, and moisture in the air. In summer it may be desirable to exclude heat from the outside and use electric fans, cross-circulation, and some times air conditioning to maintain low temperatures. Enough ventilation is needed to keep the house free from bad odors.

High-quality houses usually have most of the conditions that assure comfort. Yet a study of the plans may indicate ways of getting better comfort, such as these:

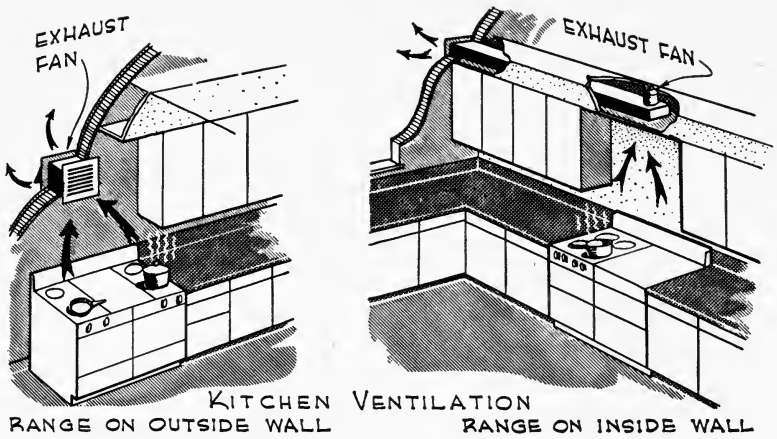


Figure 114. Use ventilating fan for kitchen comfort.

1. Provide equipment that will maintain indoor temperatures above 70°F in cold weather.
2. Have circulators and duct systems or radiation planned and installed by experts to assure uniform heat.
3. Use a minimum of 3½ inches of insulation in ceilings or under the roof, and in most areas use 1 to 3 inches of commercial insulation in sidewalls.
4. Weatherstrip windows and doors; in northern areas fit openings with storm sash or storm doors.
5. Build walls and floors with materials having low conduction values; for example, use double wood floors or overlay masonry floors with wood or composition tile, carpet, rugs, or linoleum. In exterior walls use fill-type or blanket form of insulation. Secure air space in masonry wall between the masonry and inside finish.
6. Provide air circulation in hot weather by opening windows in two walls of a room, or by electric fans, kitchen exhaust fan, or attic fan to draw cool air through the house after sunset.

FIRE SAFETY

Each year about 300 million dollars worth of property is destroyed by fire. A substantial part of the loss is from house fires.

It is estimated that about 1,000 houses catch fire each day. About three fourths of these originate from fires lighted for heating or cooking, which get out of control as the result of explosions, overheating, failure of flues, or sparks on combustible roofs. Lightning and defective flues cause additional fires; altogether some 15 causes are reported. Homes are usually not so well protected from fire as business and industrial buildings, by either

Portland Cement Association

Figure 115. Masonry construction promotes fire safety.

fire-safe construction or precautions such as sprinkler systems and watchmen. In villages and farm locations prevention is the only adequate protection.

In general, it is impractical to build "fireproof" single-family houses; in any case much of the trim, finish, furniture, and other contents are combustible.

FIRE-SAFE CONSTRUCTION. Frame houses can be made fire-resistant, however, and reasonably safe by observing the precautions noted in the following list. Most important are fire-safe flues, fire-resistant roofs, lightning rods, and inspection of utilities and equipment installations. These four items are discussed in more detail in succeeding pages. Other safety measures include:

1. Firestops. Construct the house with a subfloor over the

floor supports. Nail horizontal pieces between the uprights for fillers.

2. Use gypsum wallboard, plaster base, and sheathing because of their fire-retarding qualities.

3. Asbestos sheets on the ceiling above the heating plant in the basement and on the wall behind flues or heaters guard against damage from overheating.

4. Exterior masonry walls or brick or stone veneer afford some protection from grass fires or fires in adjoining buildings.

5. Insulate walls and ceilings with mineral or "flameproofed" insulation to help retard fire.

6. In elaborate construction make floors of reinforced precast joists and concrete or masonry floor slabs. In low-cost houses concrete slab floors may be laid on the ground or on a fill.

Fire-safe flues. Defective chimneys and flues are principal fire hazards either because of faulty construction or deterioration, or because important precautions are omitted. Following are the recommended safeguards:

1. Build chimneys on a solid masonry base; make the stack vertical throughout its length, and extend it at least 2 feet above the highest part of the roof.

2. Have a separate flue for each heating device; if two or more flues are built in one chimney stack, separate them by a brick partition.

3. Use terra cotta linings in all flues.

4. Make masonry walls at least 4 inches thick around the flue lining.

5. Construct the building so that the wood frame is at least 2 inches away from the chimney wall.

6. Embed a metal thimble in the flue wherever a smoke pipe is to be inserted. Cover holes with tight-fitting metal stop when not in use.

7. Install a cast-in-place concrete cap on top of the chimney.

8. Provide a way to get into the attic for inspection and repair of the chimney.

9. Install a damper in the fireplace, and have a metal firescreen to cover fireplace opening.

10. Use only approved materials for nonmasonry asbestos flues.

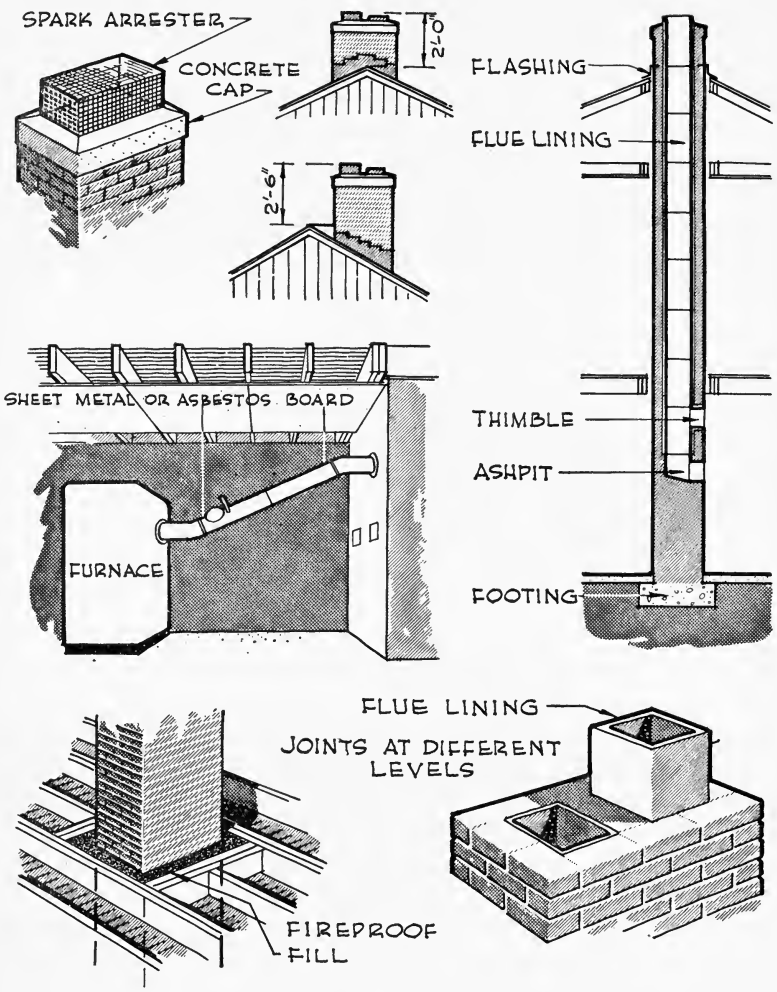


Figure 116. Safe chimneys are among the most important features of fire-safe houses.

11. It is desirable to have spark arrestors on chimneys if the roofing is not fire-resistant.

12. Make opening 8 inches square or equivalent for stove flues, and 8 by 12 inches, or 12 by 12 inches for fireplaces and central heating systems.

Fire-safe roofs. Almost all common roofs are reasonably safe if the surface is sound and in good condition. Leaves and trash in gutters may constitute a fire hazard. The greatest danger is from sparks on old wood shingles that are warped and curled, or felt-base coverings if they are torn or if the mineral coating is gone.

Wood shingles are classed as combustible, and their use is prohibited in some zoned areas. If they are used, a clear grade, no. 1 shingle should be selected; make roof slope not less than 6 inches per foot; lay shingles with not more than 4½-inch exposure, and fasten with galvanized or lead-coated nails.

Sheet metal affords a fireproof surface. Intense heat, however, may ignite wood construction beneath. Other roofings are classed as fire-resistant or fireproof. Mineral-surfaced asphalt shingles or built-up roofs will burn but do not ignite readily; they are rated in different classes as to their fire resistance. Slate, tile, and asbestos are fireproof.

Lightning. Lightning rods are most needed if the house is located away from other buildings and away from tall trees. In built-up areas, telephone and power lines, trees, and tall buildings tend to protect dwellings from lightning. Rodding gives almost certain protection against lightning. The principal requirements are: (1) upright metal rods above high points of the roof; (2) copper or steel or aluminum cable to the ground; and (3) metal rods driven 6 feet or more into the ground. Deal only with reliable manufacturers and installers.

Inspections. Fire hazards are often created by failure to use safe materials or to obtain a good installation. Some inspections are required; others should be made as a precaution. Principal inspections cover electric wiring, gas lines and appliances, and the heating plant. In urban locations where a building permit is required, inspections are made to see that local codes have been followed. In other places, the owner should obtain competent inspection. Insurance agents are usually willing to make a fire-safety check of the house and recommend improvements if they are needed.

MOISTURE CONTROL

The control of moisture is often a serious problem in new houses that are tightly built and insulated. In such houses excess

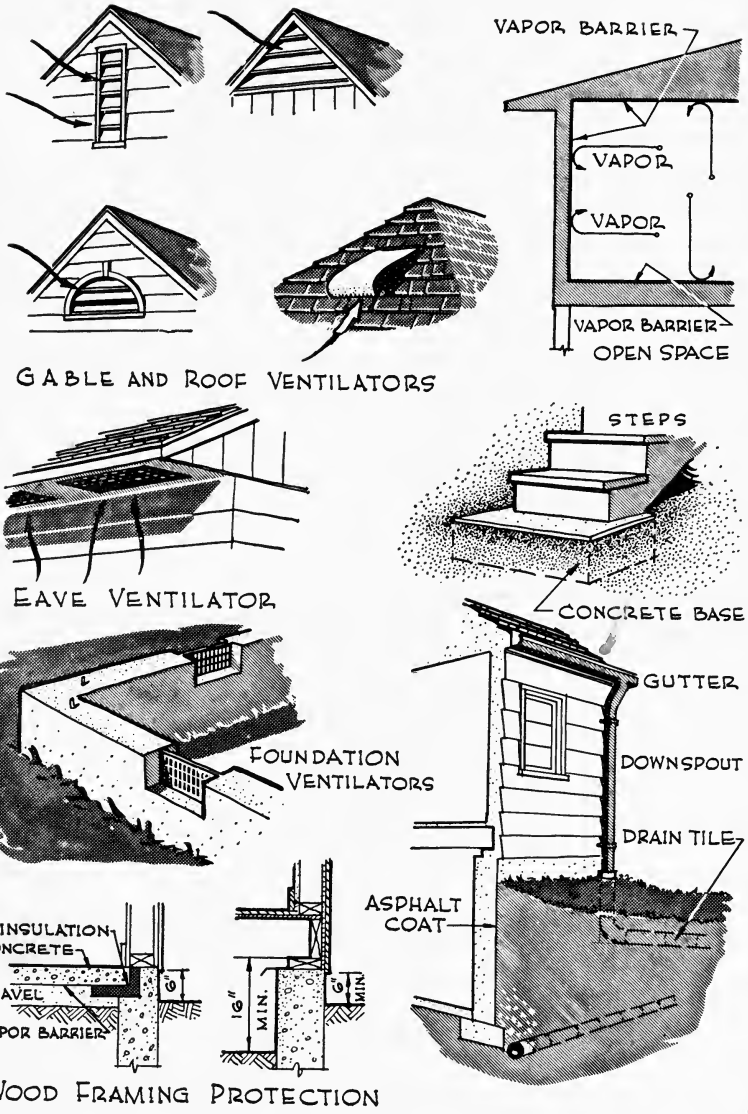


Figure 117. Protection against moisture requires many precautions.

moisture may accumulate in winter. Warm air carries much more water vapor than cold air. For this reason, a higher "vapor pressure" occurs inside the house than outside. This tends to force moisture through wall and ceiling surfaces. In cold weather, moisture condenses not only on windows and other cold surfaces but also within the walls. This may wet the wall enough to reduce insulation value and eventually cause decay. Sometimes moisture moves through wood siding and causes paint to peel off. In poorly built houses air change is rapid, and the warm air absorbs moisture and carries it out of the house, leaving the indoor atmosphere too dry.

Basements are often damp in the summer because the cool air will not hold so much moisture as normal outside air, and condensation occurs on the relatively cold walls and floors. Under some conditions of soil and drainage, groundwater seeps into basements unless tile drainage is provided and walls are waterproofed. Moisture in the soil may cause decay of wood parts near the ground. This is particularly serious in basementless houses that have continuous foundations. Grills or ventilators should be installed in foundation walls for air circulation under the house.

Undesirable moisture conditions can be largely overcome in the following ways:

1. In new houses, put a "vapor barrier" in outside walls just under the plaster or other wall surface. Vapor barriers are glossy tight papers made especially to stop moisture.
2. In masonry-walled houses, use "furring" strips to provide 1-inch air space between the masonry wall and the inside surface material.
3. Place louvers or slatted and screened ventilators in the cornice or gable ends to permit air circulation in the attic.
4. In old houses, keep water in the container in the furnace, or use humidifying apparatus in the heating system to improve winter atmosphere in the house.
5. Sometimes dampness in the basement can be avoided by using a small amount of heat in summer.
6. Construction should be planned to keep wood parts at least 6 to 8 inches above the ground on the outside. Under houses without basements, have at least 16 inches of clear

space between the soil and the floor frame unless a masonry floor is used.

7. In some cases it is desirable to use preserved or treated wood where decay is most likely to occur, such as for sills, floor joists, wooden steps, and window sash.

8. Precautions against wet basements include: (a) eave spouts and roof gutters to remove excess rainwater; (b) ground surface sloped away from the house; (c) a tile drain around the base of the foundation, and sometimes under basement floor; (d) basement wall made exceptionally tight and given two coats of asphalt waterproofing on the outside.

CHAPTER 12

Basic Measurements

To prepare plans and translate them into practical housing, it is necessary to follow the measurements, proportions, and standards that are basic to sound economical construction. Although many variations occur in the exact measurements used in building work, plans are made and structures are designed according to standard practices based on long experience. For example, framework pieces spaced 16 inches apart from center to center supply the support needed for boards or plaster. Certain sizes of doors are generally satisfactory for ordinary use. The proportions of stairsteps cannot be varied greatly from standard designs and still provide safe comfortable stairs.

Building materials are made or milled to standard dimensions both for convenience in manufacturing and handling and to fit into traditional building practices. Building sheets of plywood, gypsum, asbestos–cement, or insulation fibers are usually 4 feet wide. Lumber can be cut to better advantage at the mills and handled most effectively in even-foot lengths of 8 to 18 feet.

Many measurements are established within narrow limits by the requirements for strength and ease of handling, or to allow the combination of pieces making up a wall or floor. Measurements such as ceiling heights, roof pitches, foundation depths, and window levels are fixed by structural needs or by proportions that give the best appearance. Many dimensions, for example, in closets, hallways, porches, bathrooms, and basements, are dictated by space needs.

Economy and speed in construction are promoted by the use of standard measurements. The building industry is often criticized because of failure to adopt more complete standardization. Prefabrication tends to encourage the adoption of standard meas-

urements and sizes. Within recent years, standardization has been promoted by a trend toward "modular co-ordination."

Modular co-ordination. This term implies planning the different parts of a structure in multiples of a single standard unit of

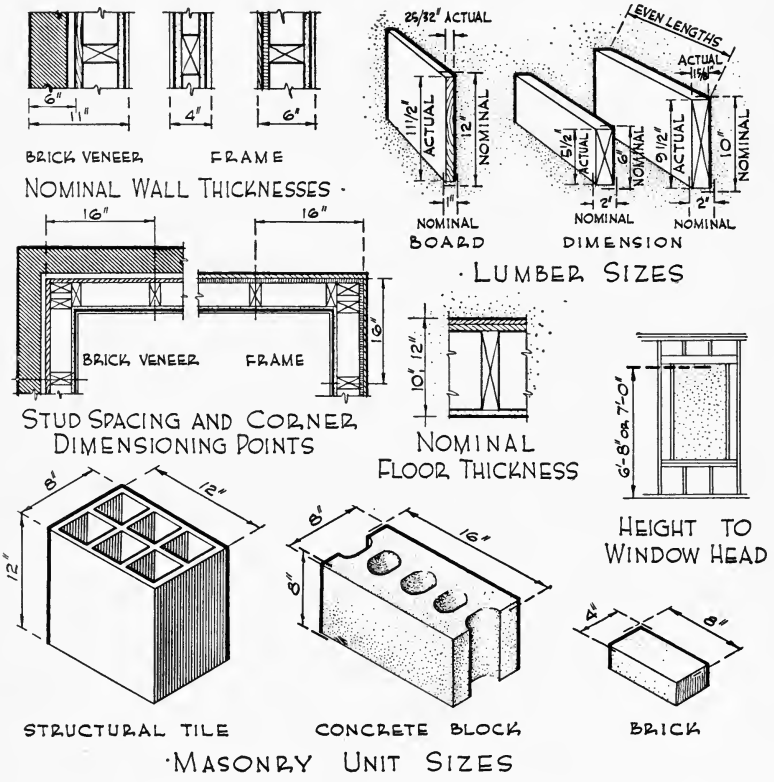


Figure 118. Examples of common materials and structural practice, especially to show basic measurements and sizes of units.

measure. The 4-inch module, or unit, has been widely accepted as the most practical for co-ordinating and relating the various parts of construction. The 4-inch module is used in many ways in house building: Wood framing is spaced at 16-inch intervals (4 modules). A common concrete building block, when set in the wall, occupies a space measuring 8 by 8 by 16 inches. Kitchen equipment illustrated in Chapter 5 is planned according to the

modular unit in its vertical measurements. Many manufacturers have adopted the modular system in doors and windows; some prefabricators build parts and panels in the same series of 4-inch multiples. Four-foot building sheets and panels conform to the module.

As modular co-ordination is more generally adopted, it will greatly simplify construction by enabling builders to erect houses from various materials without changing the basic plan; windows, doors, cabinets, stairs, and other parts will be made to fit exactly into standard spaces.

Conventional measurements. Until new methods are widely adopted and new materials are generally accepted, most houses will be built according to the common or conventional requirements. Whether fixed exactly, or varied somewhat according to local conditions, the measurements discussed serve as the best available guide to customary practices.

VERTICAL MEASUREMENTS

Vertical dimensions are used in planning to determine the proportions of the various parts from the bottom of the foundation to the ridge of the roof. The grade line is the key point in laying out and building a house.

Grade line. The grade line is the average or "assumed" finished level to which the ground will be graded outside the house. It should be slightly higher than the surrounding ground and somewhat above the sidewalk or street so that the ground surface can be sloped away from the house for drainage. On sloping lots a stake is set near the house site as a reference point and ground surfaces, terraces, slopes, or retaining walls are located in relation to this point.

Footing. Footings which form the base of the foundation are set a specified distance below the grade line. For permanent houses the footings should be placed as far down as the ground freezes in winter. The distance varies from 2½ to 5 feet in northern areas. In the South, footings should be down to firm soil; usually at a minimum depth of 2 or 2½ feet. If the house has a basement, the footing is below the basement floor line.

Basement. The usual practice is to excavate 5 feet below the grade line so that basement windows can be placed above the ground level. The basement floor line may be 6 or 6½ feet below

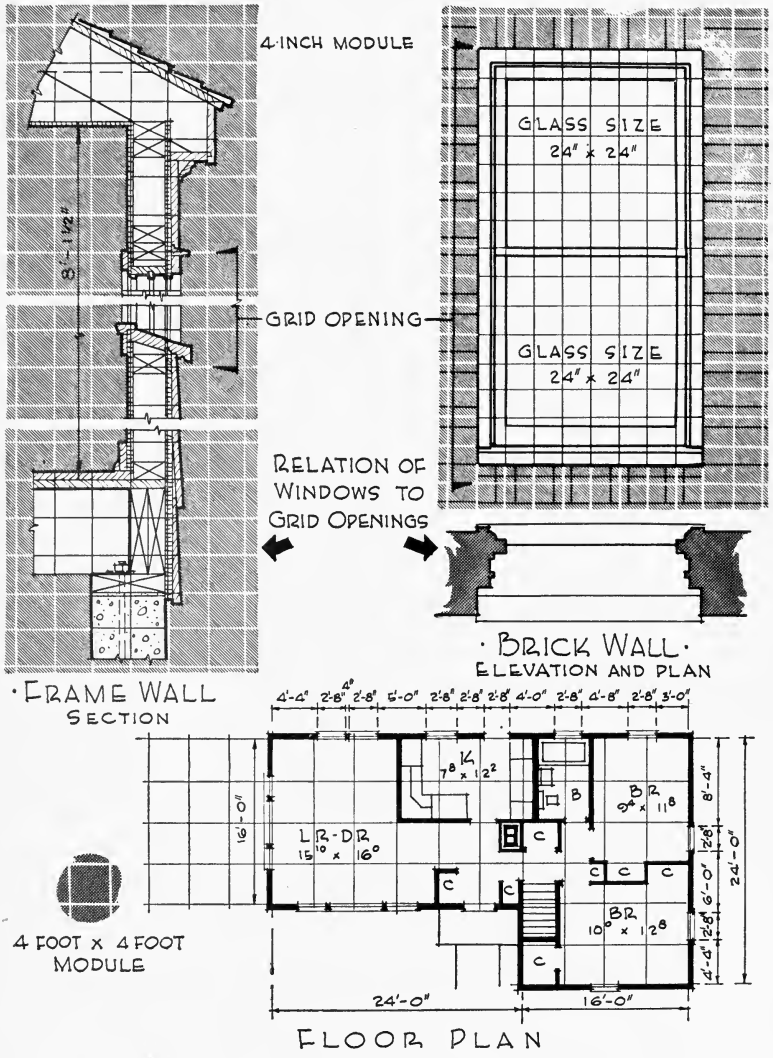


Figure 119. Modular co-ordination is based on structural elements that are fitted to multiples of 4 inches. The plan of this "industry-engineered" house is laid out on modular measurements. See Figure 1 for exterior view.

grade if the windows are set below the ground level. This requires open "areaways" built in the ground outside the windows. Deep basements increase excavation costs and make drainage and sewage disposal more difficult; yet the house should set low to the ground for best appearance.

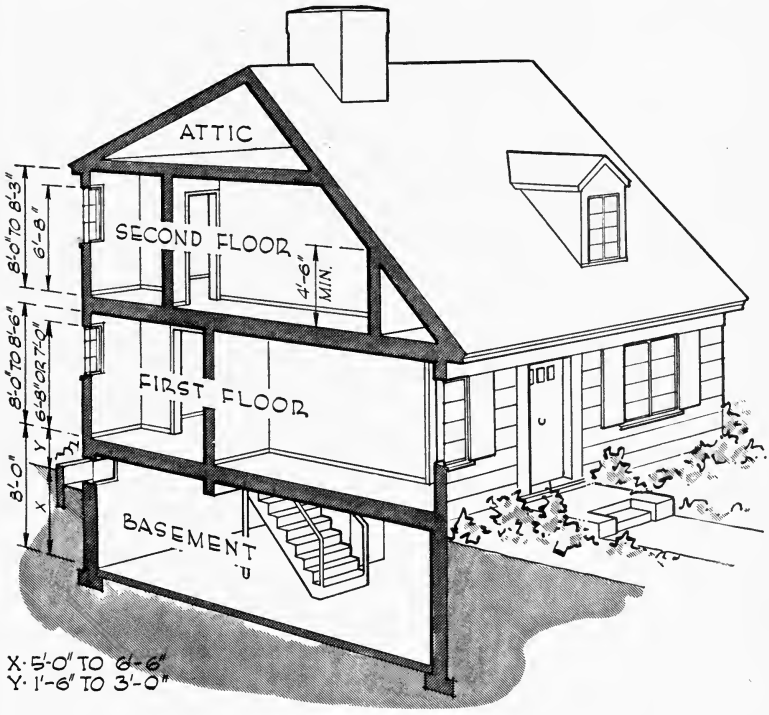


Figure 120. Section view of house showing basic vertical measurements.

Sill line. If the basement is 5 feet below grade, it is necessary to build the basement wall above ground so that the basement headroom will be at least 7 feet. This places the sill 2 feet above the grade line. If there is no basement, the sill should be 10 to 16 inches above grade to separate wooden parts from the ground for protection from damage by moisture or termites.

Ceiling heights. The 7-foot headroom in a basement provides for clearance under heat pipes or ducts and accommodates the heating plant. Room ceiling height in typical small houses is either

made 8 feet exactly to utilize the common length of wallboard materials, or about 8′–3″ which is the net height when 8-foot upright framing members are used. In full two-story houses the ceilings are usually the same height upstairs and down, although the first story ceiling height is sometimes made 8′–6″. In 1½-story houses or in finished attics the lowest part of the sloped ceiling should be about 4½ feet above the floor, to make full use of the finished space.

Headroom in unfinished attics is determined by the width of the house and roof slope. If the attic is floored and used for storage, it is convenient to have 6 or 6½ feet of headroom in the center portion. For economy, it is preferable to reduce the attic space as much as possible.

Height of openings. Except for some unusual purpose or to gain a special effect in appearance, it is best to make the tops of all openings at the same level throughout each story. The customary height is 6′–8″ from the floor to the top of arches, openings, doorways, and windows. Occasionally, openings are made 7 feet high in the more elaborate houses.

Floor thickness. The interval between any ceiling and the floor above, is 10 inches if 8-inch framework is used, 12 inches with 10-inch floor supports, and 14 inches with 12-inch pieces. This allows space for the supports, ceiling, and flooring. Supports for the attic floor are usually only 4 or 6 inches deep.

ROOF PITCHES

The usual preference in most localities is sloping roofs. The common coverings are most effective if the slope is at least 6 inches for each foot of horizontal distance. The slope is utilized to afford attic storage space, or to form part of the finished rooms in 1½-story houses. Flat roofs are entirely satisfactory if designed to carry snow loads in addition to their own weight and if the surfaces are made completely watertight.

The steepness of a roof is designated by its *pitch*. Pitch is the ratio of the vertical *rise* of the sloping part to the *span* or distance covered by the two sloping parts of a gable roof. Pitch is indicated as a common fraction in which the numerator is the *rise* and the denominator is the *span*. Since the gable roof is in the form of a triangle, the pitch may therefore, be considered as the altitude divided by the base. For example, if the plan of a house

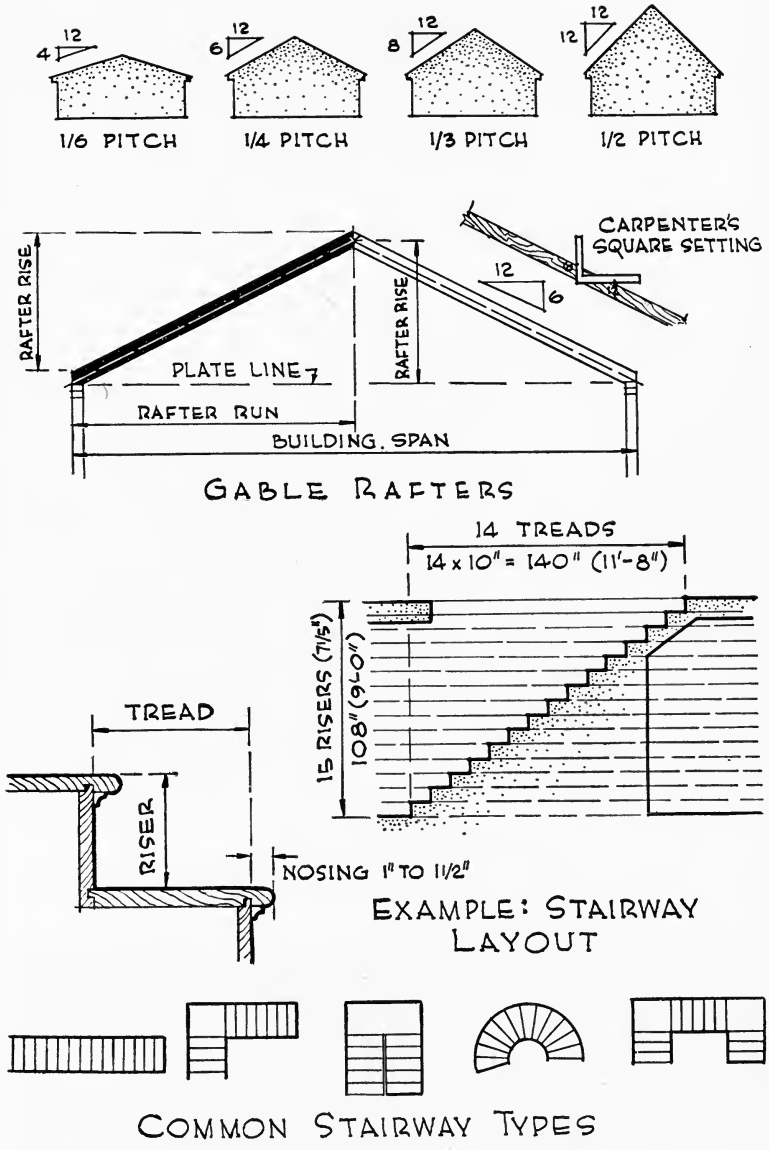


Figure 121. Details of laying out rafters and stairs.

24 feet wide shows a vertical distance of 6 feet from the base of the roof to the ridge, the pitch would be 6/24, or ¼ if reduced to lowest terms.

A ¼ pitch or "quarter" pitch is relatively low and is about the minimum for effective use of shingles. A pitch of about ⅓ is quite common; ½ pitch is generally used only when some space under the roof is to be finished, as in 1½-story houses.

Builders also refer to the roof slope by the number of inches of *rise* to each foot of horizontal distance, which is a guide to the setting of the steel square for cutting rafters. A roof slope of "six and twelve" is the same as ¼ pitch, 8 and 12 is equivalent to a ⅓ pitch, and 12 and 12 indicates a ½ pitch.

STEPS AND STAIRS

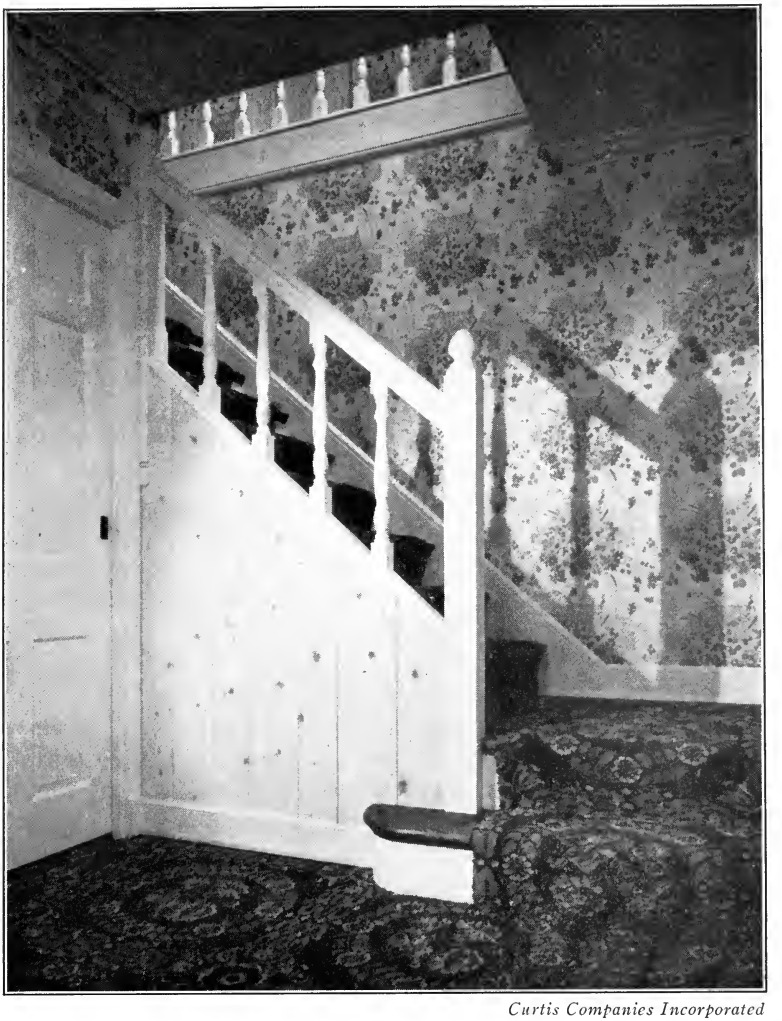
Measurements for steps and stairs are determined by the requirements for safety and ease in using them. They include dimensions for: (1) headroom, (2) riser, (3) tread, (4) width, (5) landings, and (6) total linear space required in the floor plan.

The headroom, or clear space between the steps and construction above on any part of a stairway should be about the same as for a doorway, or 6 feet, 8 inches. Usually the rise of each step of a stairway should be about 7 inches. The tread, or horizontal distance from one riser to the next should be approximately 10 inches. The pieces used as stairsteps are about 11 inches wide and are finished with a rounded edge or "nosing" that projects 1 inch in front of the riser on finished stairs.

The measurements of 7 inches for risers and 10 inches for treads are approximate, because all risers in a stair must be exactly the same height and the total must equal the vertical distance between floors. Thus, in different houses the risers may vary from about 6¾ inches, to as much as 7½ inches. Treads may be slightly more or less than 10 inches. For basement and attic stairs, risers may be a maximum of about 8 inches high, and treads should be at least 9 inches wide.

Stairways may vary from about 3 feet wide which is the practical minimum to about 4 feet in typical houses; 3½ feet is a good average. Landings at the head or foot of stairways or at turns should be the same width as the stairway.

The calculation of stairway measurements is indicated by the following example: For a ceiling height of 8 feet or 8 feet 2 inches



Curtis Companies Incorporated

Figure 122. Detail of stairway with landing.

the distance between floors will be 9 feet. A stairway consisting of a single flight of steps will have 15 risers each 7½ inches high (9 times 12 equals 108 inches; 108 divided by 15 equals 7½ inches). There will be 14 treads, since the flight begins and ends with a riser. If each tread is 10 inches, the total horizontal length of the stairway will be 140 inches or 11′–8″. This total distance

is not all taken up by the stairway on both floors, since there will be more than 6′–8″ of headroom on the lower floor under the three top steps. On the upper floor, space above the three bottom steps can be used. Therefore, some space above and below stairways can be used, or two or more flights can be placed one above another.

DOORWAYS, DOORS, AND WINDOWS

Convenience and custom has established door widths approximately as follows: For the main entrance, 2′–8″ or 3′–0″; for kitchen, basement, or service entrance, 2′–8″; for interior doors, 2′–6″ or 2′–8″; for closet doors 2′–0″ or 2′–4″; for narrow cased openings and archways, 2′–8″ to 4′–0″; and for wider openings 4′–0″ to 6′–0″. Doorways are usually 6′–8″ high and should be the same height throughout each story.

Windows are variable both in width and height. As a rule, they should be made level with doorways at the top, so the length of a window is determined by the distance wanted between the window sill and the floor. A common size for double-hung windows as designated by the glass area in each sash, is 28 by 28 inches. This requires a window frame about 33 inches wide and 61 inches high. Normally shorter windows are used in the kitchen, bathroom, and dinette in order to put the sill at a suitable distance above the floor. Basement windows are generally wide and short, so that they can be placed in the wall above the ground level. The various types and styles of windows are built in many different sizes. Generally, it is best to use only two or three sizes in one house.

COMMON STRUCTURAL DIMENSIONS

Walls. Interior house walls are commonly made with 2 by 4 framing, and a layer of plastering or other wall covering on each side. Total thickness is slightly more than 5 inches, or if the baseboard trim is counted the thickness is somewhat more than 6 inches. In planning, walls are assumed to be 6 inches thick. Occasionally, if the wall does not support the floor or ceiling above, the 2 by 4 inch uprights are set flat in the wall. In this case the wall is only about 4 inches thick. Exterior wood frame walls are also 6 inches thick, plus the outside covering. Brick veneer adds about 5 inches to the thickness. Prefabricated or manufactured

panel walls may be thinner, varying usually from 2 to 4 inches. Concrete or brick exterior walls are from 8 to 12 inches thick, depending on the method of construction. Basement walls are usually made 8 to 12 inches thick.

SPACE ALLOWANCES

Effective planning and the evaluation of plans already made require information as to floor and wall space needed for furnishings and equipment. Scaled cutouts which can be moved about on the floor plan are especially helpful in planning.* Some equipment, such as for bathrooms and kitchens, is relatively standard, but furniture sizes vary greatly. The best way to determine space needs is to measure one's own furnishings, appliances, and equipment or refer to catalogs for sizes of items in current style.

* "Cutouts to help in Planning," M.P. 622 may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for 25 cents in money order, postal note, or coin.

CHAPTER 13

House Structure

The structure of a house is made up of: (1) a foundation or base for support, (2) a skeleton of framework or other means to provide strength, (3) layers of material to enclose and finish the building, and (4) devices or accessories, such as doors, windows, and cabinets. The construction must withstand the forces of wind and snow; support loads imposed by its own weight, people, and furnishings; resist exposure, decay, moisture, fire, and insect damage; and provide the means for obtaining suitable conditions for living and working.

It is necessary to have some understanding of construction in order to compare and choose materials and methods, and distinguish between good and poor. Often a good basic method or a good material fails because it is misused. Durability and high quality are sometimes sacrificed to meet price levels. Parts hidden from view may be inadequate and remain undiscovered until it is too late to remedy the deficiency.

Structural design is based on a knowledge of forces and their effects, economical methods of building, and the characteristics of materials that make them suitable for each specific use. It is, therefore, necessary to depend on architects, engineers, and designers for basic construction plans, technical information, and recommendations. The prospective home owner can protect his interest by insisting on expertly designed plans, complete specifications, competent consulting services, and reliable contractors and builders. To aid in understanding and solving these problems, emphasis is given in this chapter to typical requirements and practices and to the definition of the various elements of the structure.

TYPES OF CONSTRUCTION

Only two general types or methods of construction are used in building single-family houses: (1) prefabrication, and (2)

"conventional" or on-site construction. "Frame" construction, which is the most common, depends for strength on a framework of wood or metal. Some houses are masonry structures, built of cast-in-place concrete, or of masonry blocks, bricks, hollow tile, or stone. Modifications and combinations are made to produce

Hedrick-Blessing

Figure 123. Old style timber framing. See Figure 124 for modern adaptation.

"veneered" walls, plastered outside walls or stuccoed surfaces, and frame houses with masonry floors. Other systems of building make maximum use of a single material, such as concrete, plywood, aluminum, or glass.

Some unique or special designs have been developed by utilizing materials in a new way or by varying conventional methods

without sacrificing durability or safety. Some examples are: (1) concrete houses cast in place over removable forms, (2) lightweight structural members formed of metal by shaping and welding, or of wood by nailing, bolting and gluing, and (3) post and beam framework with flat panels filled in between supports. Special designs are based on characteristics of materials and

Celotex Corp.

Figure 124. Modern adaptation of post and girder frame, used with wall panels.

methods that tend to assure durability, strength, and economy. Usually they are variations of standard designs in frame or masonry, or they embody some features of prefabricated panels, units, or sections.

PREFABRICATION

Prefabrication is a comparatively new method of house construction; little use was made of this system prior to World War II. Much wartime prefabrication consisted of temporary housing units or emergency types of construction, some of them of doubtful value. Postwar prefabrication is better established, and houses

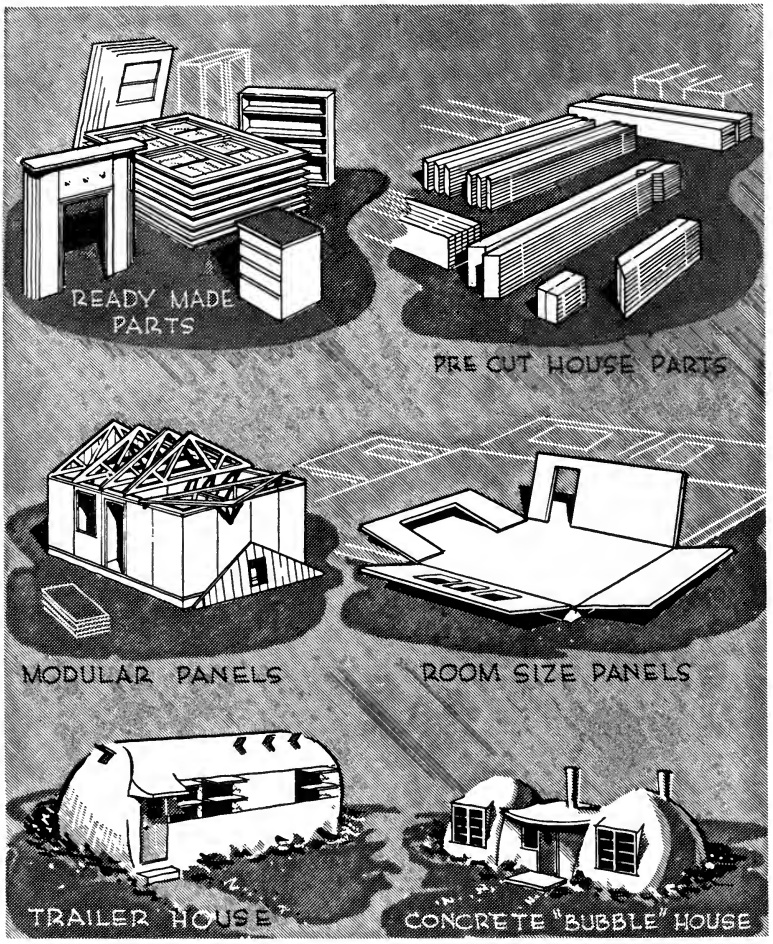


Figure 125. Structural methods. Center diagrams are most nearly typical in prefabrication.

built by this method may have quality, permanence, and value comparable to similarly priced conventional houses. Since prefabrication denotes a method of assembly and erection, rather than a distinctive kind of structure, most prefabricated houses are also "frame" houses. The trend, however, is to develop new combinations of materials, and sheets, panels, or shapes especially suited to the system.

Most present-day prefabricated houses conform to commercial standards as recommended by the National Bureau of Standards, and issued by the U. S. Department of Commerce. The standard specifications are intended to prescribe adequate and acceptable houses which are eligible for financing under insured loan plans and which conform to typical building codes.

Lustron Corp.

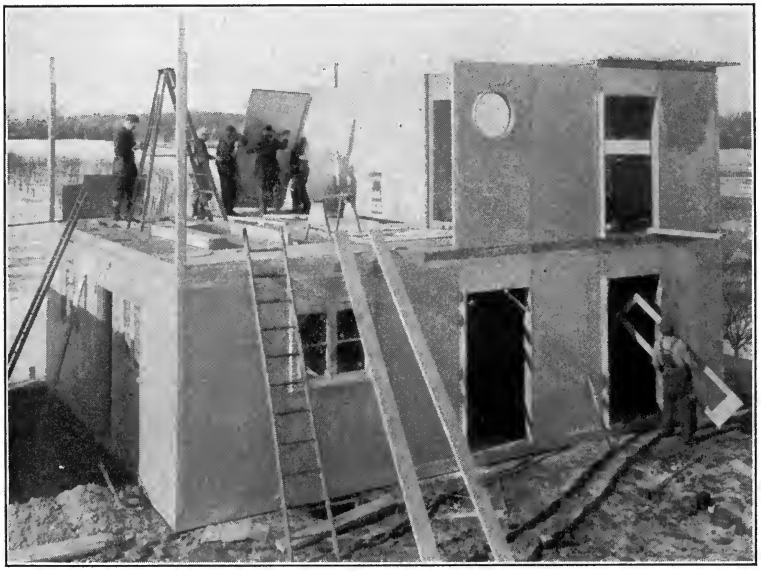
Figure 126. Prefabricated design, largely metal construction, both in framework and covering.

As applied to housing, prefabrication means the manufacture of parts, units, or sections of a house in a mill, factory, or assembly plant. Walls, partitions, floors, ceilings, and roof sections or panels are transported to the site and assembled on the building foundation. The foundation and basement are constructed on the site. Generally the utilities, roofing, finish floors, paint, and other items are installed or applied as they are in ordinary construction.

Ready-made cabinets, doors and windows, plumbing fixtures, and other manufactured parts are "prefabricated" only in the sense that they are completed before being taken to the building site. House trailers and other housing units which can be readily

moved from place to place are factory-built, but they are usually classed as personal property rather than real property or real estate.

Because prefabrication is relatively new, various obstacles remain to be overcome. This type of construction is prohibited in some urban areas. Transportation costs limit the area which can be served from one factory. Methods of construction, materials, and quality vary widely among the many manufacturers.



Forest Products Laboratory

Figure 127. Panel-type prefabrication, wood framing.

The merits of any prefabricated house should be determined before purchasing. Advocates of on-site building contend that no financial advantage is gained by prefabrication. The development and acceptance of the method depend on the eventual economy, structural quality, and the value given to speed of erection.

Several practices closely related to prefabrication are used in conventional construction. They include the use of factory-made house parts, installation of utility units or assemblies of equipment, and general use of manufactured building sheets, end-

matched boards and flooring, and framework pieces cut to exact length with the ends squared.

Large-scale builders follow many procedures similar to prefabrication by using machine methods and mass production at or near the site. Special crews of workmen move from house to house at the proper stage of completion. Power machines are used for cutting materials, mixing concrete, excavating, elevating materials, and other jobs.

Forest Products Laboratory

Figure 128. Completed group built as shown in Figure 127.

CONVENTIONAL CONSTRUCTION

Conventional construction is a step-by-step process of cutting, fitting and assembling parts and pieces of material on the site, together with other operations necessary to produce a complete building.

Construction requirements vary with local codes, building practices, kinds of material used, size of the house, and the quality level. Thus, it is not possible to define construction in terms of sizes, materials, and methods, without a great amount of detail. Standard or stock items are generally used. Common requirements

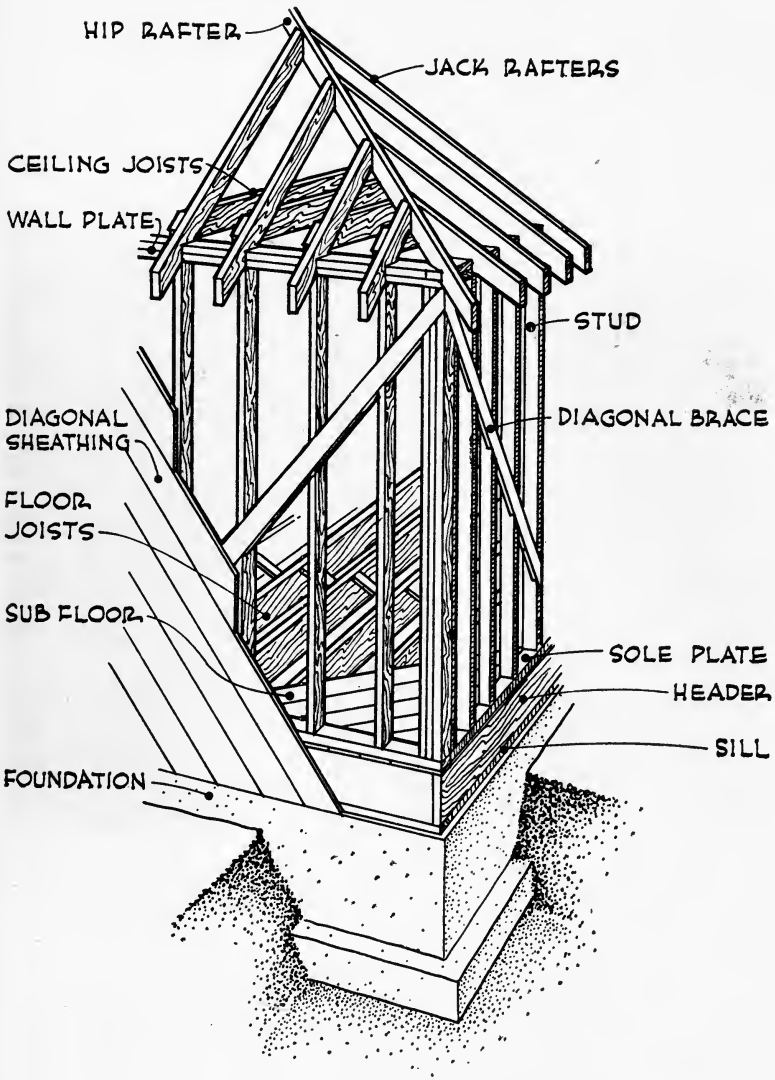


Figure 129. Elements of conventional wood framing.

are implied here in statements that give the spacing of framing parts, the kinds of framing, and the purpose of various items. It is not possible to cover such things as the methods of assembling

and nailing; the practices followed by craftsman; or the make-up of plaster coatings, paint finishes, cornice construction, or door and window parts.

Typical plans obtained from architects, contractors, lumber dealers, or public planning services show details of construction. Numerous books and bulletins on building methods are available also (see Appendix B).

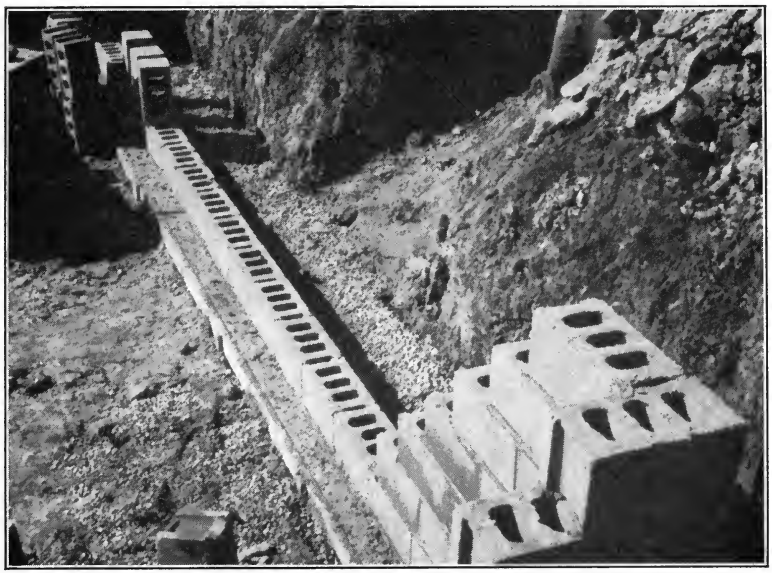
Portland Cement Association

Figure 130. First steps in construction: Excavation and footings. Note "batter board" and chalkline.

In logical order, construction includes: (1) excavating, (2) building the foundation, (3) framing, (4) making rough enclosures, (5) preliminary work of installing utilities and equipment, (6) adding surface layers, (7) installing equipment, (8) placing millwork, and (9) painting and finishing. The following outline gives the step-by-step procedure and illustrates the principal operations:

Staking out. Locate the front line of the house with respect to streets, property lines, other buildings, and compass direc-

tions. Square the corners and measure outside lines. Check exactness of the layout by making sure the diagonal lines are equal. Set stakes and corner boards several feet from each corner and mark projections of each outline of the house so corners can be relocated.



Portland Cement Association

Figure 131. Basement wall of masonry units on concrete footing.

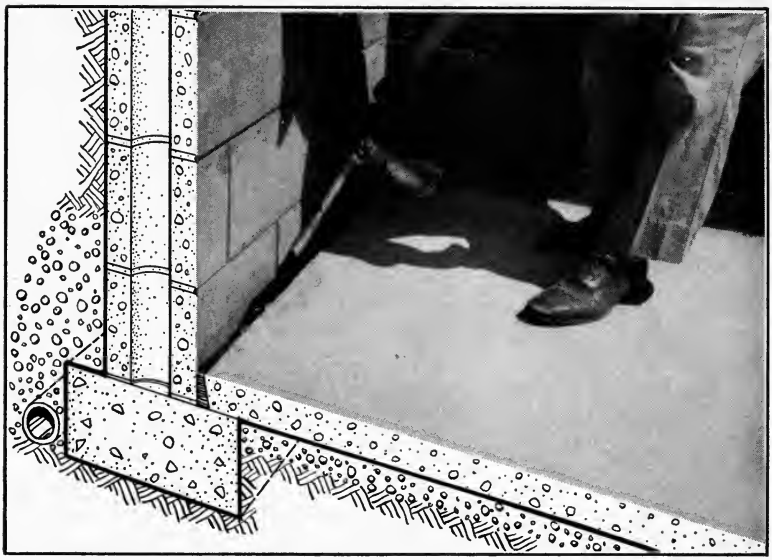
Excavating. For a house without basement dig trenches for foundation, post supports, sewer, water lines, and gas service. Remove soil from inside the foundation walls to assure a distance of at least 16 inches between the ground and floor frame. If the house has a basement, excavate to full depth, separating topsoil and subsoil for use later in grading the lawn. It is preferable to excavate 1 foot beyond foundation lines.

Building the foundation. Broaden the foundation at the bottom to obtain firm support. It is usually preferable to construct the footing as a first unit and then erect the rest of the foundation on it. Install drain tile outside the footing. Construct forms for basement walls and pour cast-in-place

concrete, or build with blocks, bricks, or tile. Place supports for posts, chimneys, and basement partitions.

Waterproofing. Apply waterproofing materials to the outside of basement walls up to the ground line.

Anchoring. Connect foundation to sills by means of anchor bolts embedded in the masonry.



Portland Cement Association and Keith Hinchcliff

Figure 132. Details of footing, foundation, drain tile, floor, and waterproofed joint.

Framing. Erect framework in the following order: (1) sills, basement posts, girders, and floor frame, (2) subflooring, (3) first-story outside wall and partition frames which are assembled on the subfloor and raised into position, (4) second-story floor frame, subfloor, and walls as for the first floor, (5) ceiling or attic floor frame, and (6) roof frame, gable ends, and dormers.

Enclosing the frame. Cover outside walls with boards or building sheets, and apply roof boards for wood shingles, or solid sheathing for other roofings.

Building flues. Set brick flues on reinforced-concrete base,

install cleanouts and thimbles, line with fireproof flue tile, keep flues independent of house frame. Extend vertically to 2 feet above highest point of roof, place metal flashing at junction with roofing, and finish with cast-in-place concrete cap.
Roughing in for utilities. Install wires, piping, drain lines, plumbing stack, and heating pipes or ducts after frame is erected but before inside walls are enclosed.
Roofing. Apply roof covering as soon as possible after the frame is enclosed.
Placing exterior frames. Set and attach window and door frames in outside walls.
Siding. Cover sheathing with waterproof building paper, and complete the outside walls with siding or masonry veneer and trim.
Painting. Paint window and door frames before placing them in the wall; paint exterior wood parts with one coat as soon as possible, and finish coats when construction is complete.
Insulating sidewalls. Use blanket, or batt-type insulation; place vapor-barrier paper on the inside of the wall frame.
Plastering. Apply metal, gypsum, or wood lath, and plaster the walls; or use paneling, building sheets, or other wall and ceiling surfaces.
Insulating overhead. Insulate between rafter spaces if attic is to be finished, or above ceilings, using batt-type or loose-fill insulation.
Installing millwork. Complete construction by installing inside door frames, doors, window sash, setting stairs, and trim.
Flooring. Apply finish floors; use a waterproof paper under wood floors. Concrete floors in basement may be laid at any convenient time after the framing work is started.
Placing equipment. Set plumbing fixtures, heating plant, and other installed equipment.
Finishing. Sand wood floors to a smooth surface, and finish as desired; paint, varnish, or otherwise finish woodwork and walls.
Completing. Grade the lot to its final surface, place sidewalks and steps, fit and install screens and storm windows, and complete other items according to the contract or the specifications.

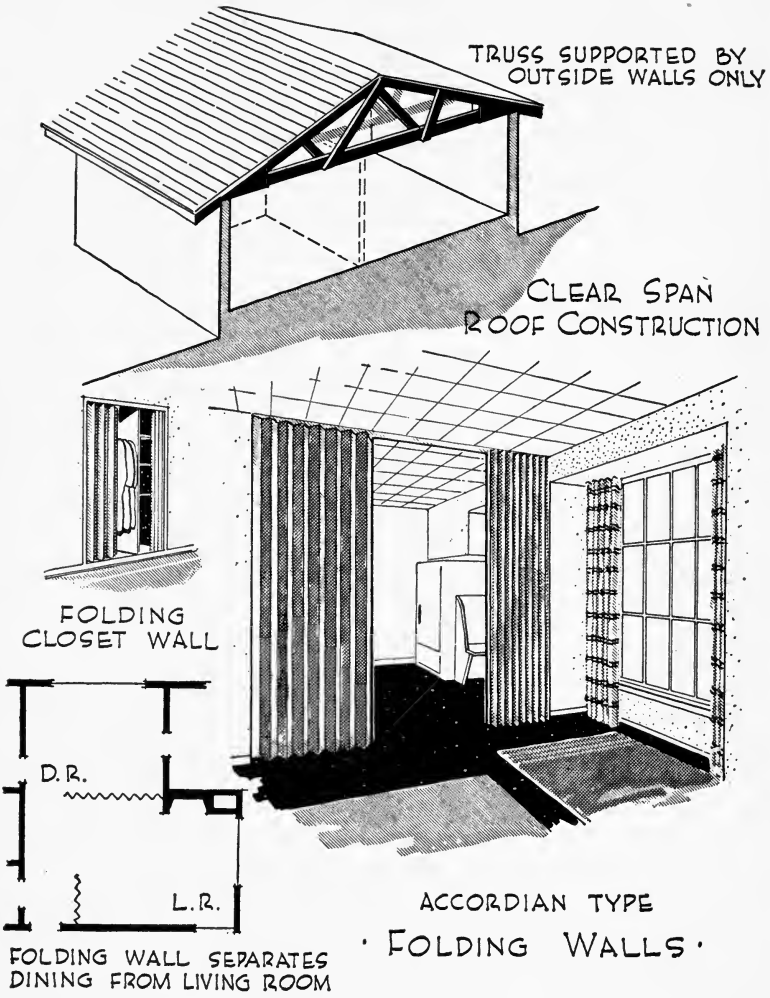


Figure 133. Recent construction practices include clear-span roof and folding walls.

DEFINITION OF PARTS

Much of the ability to interpret plans and construction and decide on choices of materials and methods depends on understanding the terms used to describe construction. The important parts or elements of the typical house are defined in the following

list. The definitions and descriptions are those ordinarily used by architects, builders, and dealers. For convenient reference, the list is divided into two groups: (1) frame structure and parts, and (2) other structural parts. The lists are in alphabetical order.

FRAME. The entire assembly of pieces, usually wood, but sometimes metal, making up the skeleton or framework of floors, walls, ceilings, partitions and roof.

Balloon frame. Construction in which the outside wall is made with continuous uprights extending from sill to top of wall.

Metal frame. Construction in which the principal uprights, floor supports, roof rafters, and braces are metal; usually steel, with a minimum of wood parts. Steel may be welded or bolted.

Platform frame. A method of construction in which the sill, floor framework, and subfloor are built as a platform on which the walls are erected. If the house is two stories high, the second floor is built as a platform on the first-story walls.

Timber frame. A type of construction using posts, girders, and braces heavier than usual 2-inch dimension lumber. Lighter pieces or panels are used to fill in between the framing pieces.

FRAME PARTS. The principal members in the wood frame house are those which make up the structure of floors, walls, ceilings, and roof. Following are the essential items:

Bridging. X braces between floor supports to give rigidity to the floor frame, reduce vibration, and distribute loads. Pieces of 1-by3-inch wood are cut to fit and nailed at the top before the subfloor is laid. Nailing is completed after the entire framework of the house is in place.

Girder. A horizontal support which rests on walls or posts under the floor frame. Steel beams are recommended; or a continuous wooden piece may be built up of several 2-inch planks placed on edge.

Header. Any piece of framing material crosswise of joists, studs, or rafters to form an opening for a door, window, flue, or stairway. Usually doubled above windows and doors, and around stairways to offset the loss of strength caused by the opening in the framework.

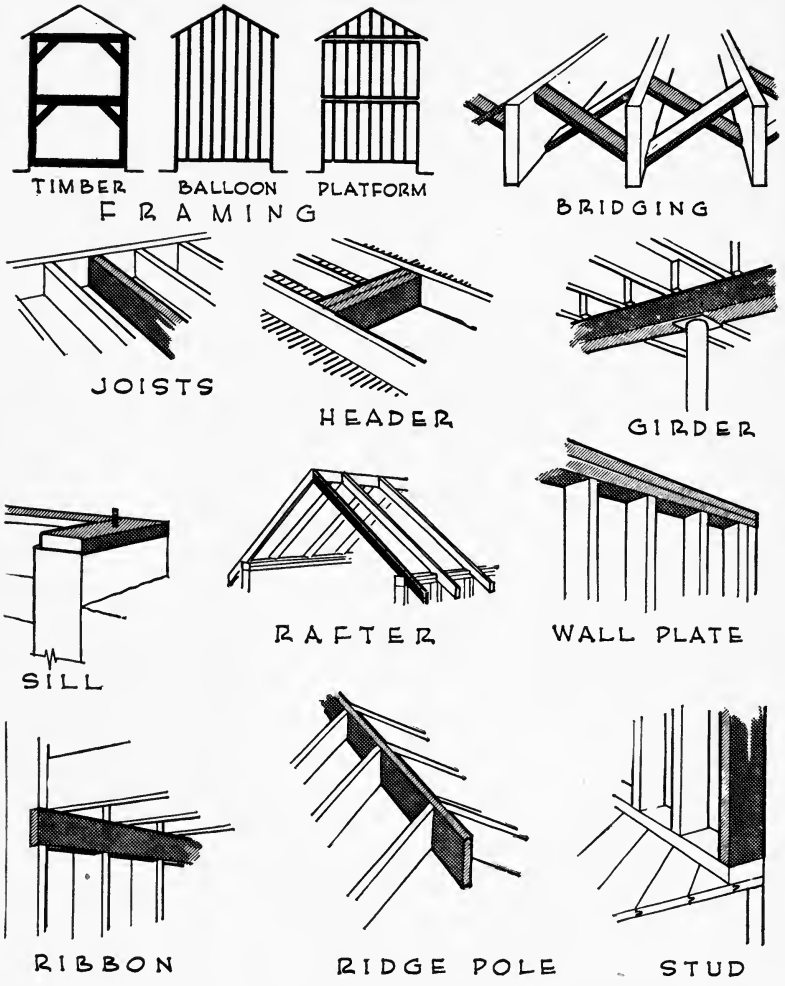


Figure 134. These sketches illustrate typical elements of the house structure.

Joist. The principal item in the floor frame. Two-inch lumber, 4 to 12 inches wide, depending on the load to be supported and the length of pieces. The usual spacing is 16 inches, center to center. Joists are doubled under partitions and at stairway openings.

Plate. The cap piece or top horizontal member of walls to

hold the studs at the top and give rigidity to the wall. Usually doubled; one piece is attached before the studs are raised in position, and the other nailed on later.

Rafter. The sloping framework piece extending from the wall plate to the ridge of the roof, to form the roof frame. Rafters are set in pairs, spaced either 16 or 24 inches from center to center. They are notched to fit firmly on the wall plate and cut to match at the ridge. Short pieces called "collar beams" are nailed to each pair of rafters at the ridge. Long rafters are supported about midway between wall plate and ridge by a "purlin" or support set at right angles with the rafters.

Sill. The bottom unit of the frame attached to the foundation. This flat sill is sometimes called the mudsill because it is leveled and set in mortar. Usually another piece is set edgewise on the mudsill, making a "box" sill. This provides for proper nailing of the floor frame and subflooring.

Stud. Upright wall framing member, usually 2 by 4 inches in house construction, which extends the full height of each story in the platform frame, or from floor to roofline in the balloon frame. Standard spacing is 16 inches, center to center of pieces. Three studs are used at corners, both for strength and to provide nailing space for wall finish; and two pieces are used at openings in the wall.

Other frame items. Many plans indicate other framework items such as "firestops," or blocks in walls between studs; "ribbon," or board notched into studs to support joists partially in ballon framing; "trussing," or special blocking above wide windows to support the structure above; ridge piece, or "ridge pole," a horizontal piece along the top of the roof, between rafter ends; and stair "horses" or sloping supports for stairsteps.

Other structural parts. The following are part of the "frame" house, but are not defined as items of framing in the foregoing list:

Anchors. Attachments to connect wood or metal framework to masonry; generally bolts embedded in the foundation. Bolts 12 to 16 inches long are set at intervals of about 6 feet.

Bracing. In general, any block, tie, plank, or board used to prevent sagging or distortion; they are most effective when placed diagonally. Typical braces are those set diagonally

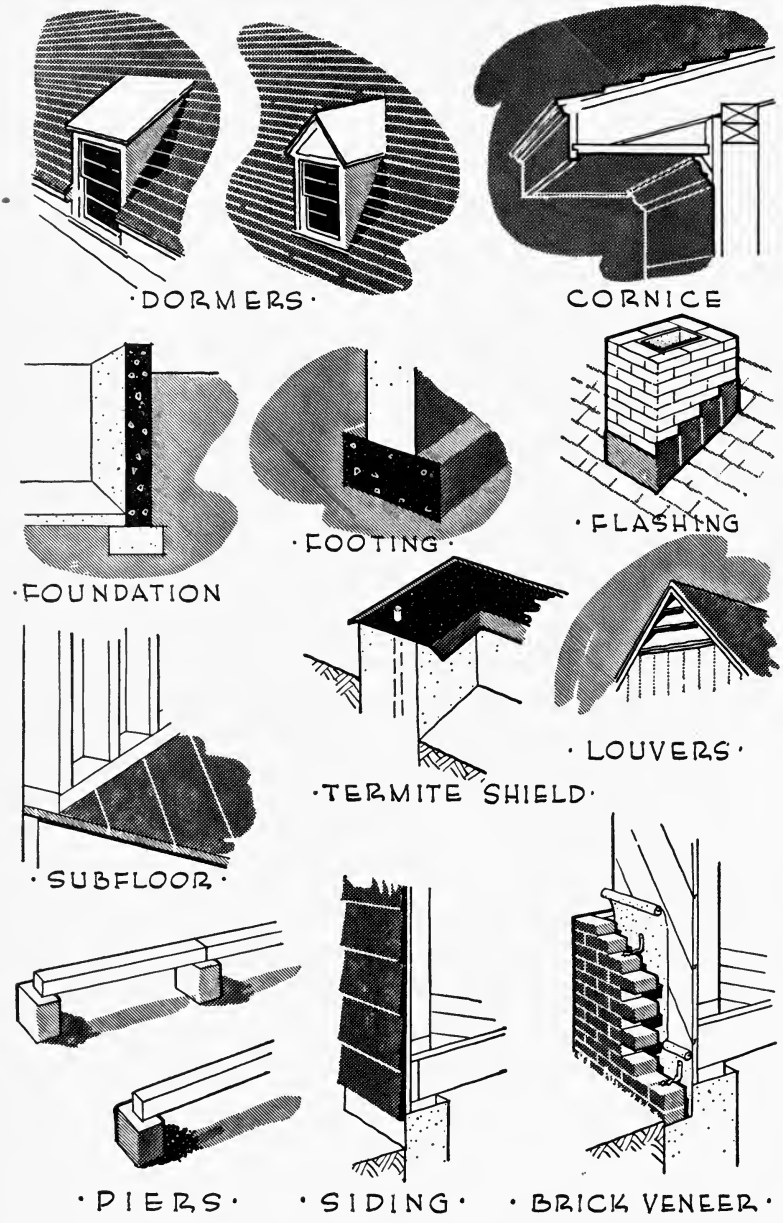


Figure 135. More details to visualize structural parts.

between uprights to stiffen the wall and supports used to strengthen the roof.

Cornice. The projection of the roof beyond the walls, together with the finishing boards and moldings.

Decking. Same as roof sheathing; solid or tight layer over the roof frame. Usually 1-inch boards but may be heavy plywood or gypsum board.

Dormers. Projecting structures in a sloping roof to provide a means for installing windows in attics or in finishing rooms in 1½-story houses.

Flashing. Metal strips or pieces used to cover the junction of two parts or sections to prevent the entrance of moisture, such as around roof dormers, above windows, at roof intersections, connection between walls and roofs, and where flues or plumbing stack extend through the roof.

Footing. The broadened base of the foundation, which supports the weight of the house on the ground. Placed below the depth to which frost penetrates in winter, and made level throughout. Also, the concrete base for chimneys, posts, or piers.

Foundation. Masonry wall, including the footing, or placed on it, and extending 8 to 24 inches above ground to form the basement wall, and to support the frame or superstructure.

Foundation drain. A line of drain tile laid outside the foundation at the footing, and conducted to an outlet. Usually 4-inch farm tile, laid on a slope of at least ⅛ inch per foot.

Furring. Stripping, usually 2-by-2-inch wood pieces, fastened to masonry walls in order to provide a 2-inch air space between wall and inside finishing material.

Gutters and down spouts. Troughs, usually metal, attached to the eaves, together with pipe conductors to receive and carry rainwater from the roof.

Insulation. Any material incorporated into walls, ceilings, or roof especially to retard passage of heat. One-inch rigid insulation may be used in place of sheathing or as inside wall material. Blanket, batt, or fill types should be 1 to 3½ inches thick in sidewalls and 3½ to 4 inches overhead.

Louvers. Slatted ventilators to give air circulation in attics or in rooms if windows have fixed glass sash that cannot be opened.

Portland Cement Association

Figure 136. Furring strips separate plaster or other wall finish from the masonry wall. Blanket insulation placed between furring strips.

Masonry wall. Brick, block, tile, or stone walls extending all or part way to the roofline. Such walls are load bearing and replace the wood frame and the enclosing layers.

Piers. Short posts, usually of masonry to support the house frame, commonly used for intermediate supports in houses without basements, and instead of continuous foundations in low-cost construction.

Posts. Columns to support porch roofs or to carry the load on beams or girders under floors. Steel posts are recommended in the basement.

Roof strips. Also called roof boards. One-inch boards, preferably 6 inches wide and spaced 2 inches apart, to which wood shingles are nailed.

Sheathing. An enclosing layer of boards or building sheets, approximately 1-inch thick applied on the outside wall frame. Sometimes called "boxing." Also the layer on the roof frame to which roofing is attached.

Siding. The finish material applied to the outside wall. Usually placed over sheathing and paper, but nailed directly to

framework in low-cost construction in mild-weather areas. May be wood, shingles, or manufactured sheets or panels.

Stucco. Exterior plaster applied to masonry walls or on metal mesh attached to the outside wall as a finish surface.

Subfloor. Underfloor, usually of 1-inch boards laid diagonally on the floor frame, to serve as a base for the top or finish floor. Recommended in all cases and required when hardwood flooring is used in frame construction.

Termite shield. A metal strip or plate placed between foundation and wood sill, and extending beyond the edge of the foundation.

Vapor barrier. A dense glossy paper, metal foil, or paint, applied on or back of the inside surface material in the outside walls.

Veneer. A single layer of brick, stone, or other masonry units usually 4 to 5 inches thick, built up as a surface layer on outside walls. Veneer replaces siding, and is attached to the wall by metal connections; it is not in itself a supporting wall.

Waterproofing. Coating on the outside of basement walls, usually two coats of an asphalt waterproof material, brushed or mopped on.

A CHECK LIST OF STRUCTURAL DEFECTS

Good construction is taken for granted in the absence of defects; therefore, it is logical to evaluate a house by observing each part for evidence of weak, defective, cheap, or unsatisfactory features. The following list indicates the principal deficiencies to look for:

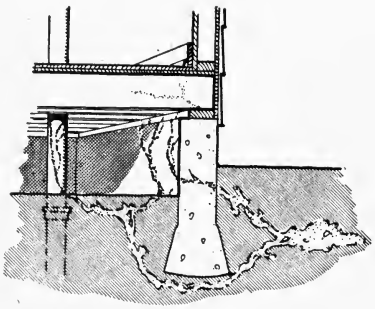
Foundation. 1, Settled; 2, cracked; 3, crumbled mortar; 4, broken segments; 5, tilted; 6, moisture leaks.

Exterior walls. 1, Broken parts; 2, warped; 3, cracked boards or masonry; 4, much weathering; 5, loose nails; 6, open joints; 7, ill-fitting doors and windows; 8, decayed parts or porches.

Roofs. 1, Leaks; 2, warped shingles; 3, rusted metal or nails; 4, rusted flashings and valleys; 5, surface badly weathered.

Chimneys. 1, Set on brackets; 2, unlined; 3, tilted; 4, loose mortar; 5, no cap; 6, two or more openings in one flue.

Doors and windows. 1, Loose; 2, putty gone; 3, glass broken; 4, frame decayed; 5, cannot be opened easily; 6, broken hardware.



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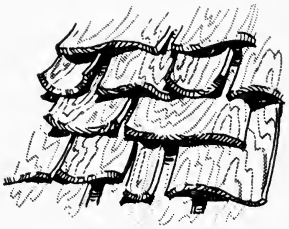
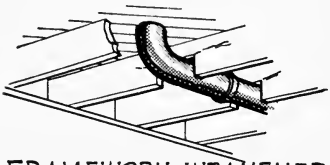
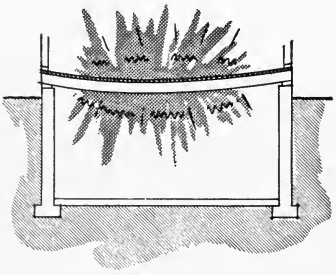


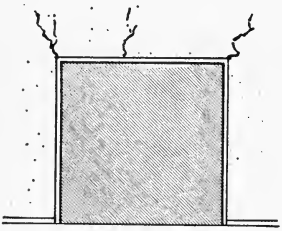
WARPED SHINGLES



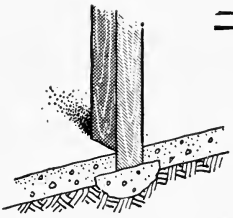
FRAMEWORK WEAKENED



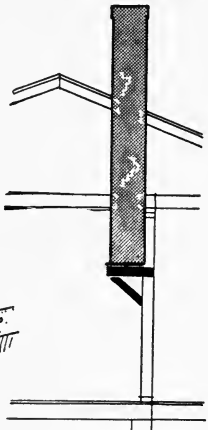
UNDERSIZE JOISTS



LACK OF BRACING OVER OPENING



NO COLUMN BASE



INADEQUATE CHIMNEY SUPPORT

Figure 137. These details serve to emphasize a few of the many things to look for in judging a house.

Exterior paint. 1, Worn out; 2, peeled; 3, blistered; 4, discolored.

Interior walls and ceilings. 1, Cracked; 2, patched; 3, discolored; 4, flimsy; 5, not waterproof in kitchen; 6, warped; 7, loose paper; 8, poor condition of finish.

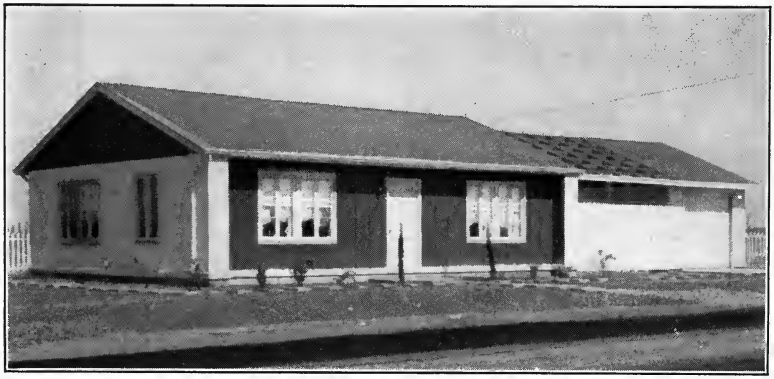
Floors. 1, Uneven; 2, shaky; 3, cracked; 4, splinters easily; 5, rough; 6, unfinished; 7, exceptionally dark.

Stairs. 1, Narrow; 2, steep; 3, winding; 4, parts broken; 5, treads worn; 6, risers uneven; 7, without hand rail.

CHAPTER 14

Choosing Materials

Many different materials are used in housebuilding to obtain the best combination of economy, durability, and appearance. Sometimes only one material is fully satisfactory for a given purpose; for example, concrete for footings or basement floors. In other cases, any one of several materials might be equally



Precision Homes Co.

Figure 138. Effective use and combination of materials in a prefabricated house.

suitable. Then the choice depends on availability, cost, and preference.

Wood, steel, concrete, and brick are widely used both because they are readily available at relatively low cost and because each has many useful qualities. As new and improved materials become available, if they have desirable characteristics, they tend to replace common materials.

In any locality the best choices are likely to be materials which either are produced in the community or are in sufficient demand to be kept in dealer's stocks. Within each class, only a few kinds, types, and species are commonly used. Rare woods, specially made parts, and unusual designs are much more expensive.

Celotex Corp.

Figure 139. Applying manufactured panels on post and girder frame. See Figure 124.

REASONS FOR CHOICES

The principal reasons that determine the choice of materials are:

Cost and economy. Stock or standard items cost less than special parts or designs. Often it is not necessary to purchase top grades of materials since there may be little or no difference among the grades in strength, durability, or appearance. To obtain lowest cost it may be best to use roughsawed lumber from local timber, concrete made with ungraded sand and gravel, and the less-expensive grades of manufactured materials.

Lustron Corp.

Figure 140. Use of metal in house framework.

Acceptability. Building codes or regulations may prohibit certain materials because of fire hazard or for other reasons. Workmen usually prefer to use materials to which they are accustomed. Some condition of climate such as salt air, alkali dust, heavy rainfall, frequent high winds, or alternate freezing and thawing may prevent the use of some materials. Style preferences may result in wide popularity of stone, brick, steel, or composition materials.

Fitness for the purpose. Materials are selected for their performance under conditions of use. For example, parts in contact with the ground must resist moisture, insects, and decay. Roofing should be fire-resistant and durable under exposure. Framing must protect against damage from windstorm and provide a firm support for the enclosing materials. Walls must be suitable for a variety of finishes and decorative effects; floors should be made of materials that give a smooth finish and can be readily cleaned; and flues must be fireproof.

Ease of working and handling. Fresh concrete can be shaped into forms; lumber is easy to cut and fit; manufactured sheets of plywood, gypsum, insulation, or asbestos–cement can be applied more readily than individual boards. Bricks are small enough to be lifted easily; yet they can be formed into solid durable structures. The increasing use of factory-made parts is partly due to the ease of using them on the job.

DESCRIBING MATERIALS

When materials are listed, they should be described precisely enough to prevent misunderstanding among those concerned with building a house. It is not sufficient to use general terms, such as "concrete," "composition roofing," "sheet metal," or "insulation," since the terms are not exact enough to describe the material specifically. It is necessary to describe materials by color, weight, thickness, finish, grade, or composition in detail that will differentiate one kind or quality from others in the same class.

Generally, it is better to describe materials by characteristics rather than by brands or trade-marks. For example, "Portland cement" is a general term, whereas "Atlas" or "Marquette" are trade-marked brands. Since Portland cement is a standard product in the United States, a detailed description is not necessary. But it is sometimes essential to state whether the cement is to be supplied in cloth bags, paper sacks, or in bulk. In addition to ordinary gray cement, other cements are especially made for quick-setting qualities, white color, or as an ingredient for mortar or plaster. Other materials require descriptive statements in greater or less detail, according to the choices available.

SPECIFICATIONS

Specifications are the statements that describe materials and give other information not shown on the plans, such as the quality of workmanship and methods to be followed. On large-scale buildings, specifications are written in great detail. They should be a part of the agreement on any contract work. House specifications usually can be prepared by following standard forms or outlines and filling in the descriptions of materials. Unless the prospective owner employs an architect, he should become familiar with qualities and available choices. One of the best guides is the

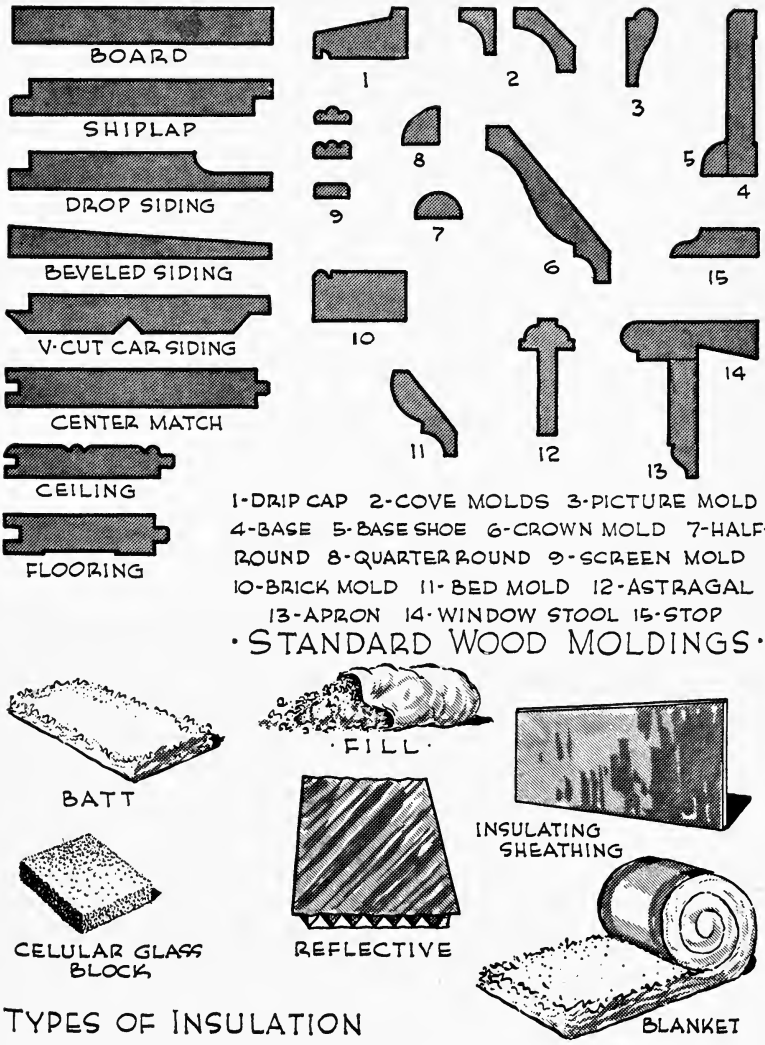


Figure 141. Standard wood-finish lumber, molding, and types of insulation.

statement of requirements for houses eligible for FHA financing. Copies may be obtained from agencies that handle such loans.

LUMBER

Lumber is especially favored for construction because of the many ways in which it can be used. It is easily worked, readily

fastened in place, and well-adapted for such uses as framing, enclosing layers, shingles, siding, finish, millwork, and trim. Under good forest management and modern methods of manufacture, new timber is grown and processed efficiently to assure supplies for many years to come.

Relatively few kinds of lumber are used in housebuilding. Douglas fir and Southern yellow pine are by far the most common species of softwood lumber (produced from cone-bearing trees). Some hemlock, cypress, redwood, and other species of pine are used. Among the hardwoods (from broadleaf trees) oak is the most common both for floors and trim and for framing and board lumber in hardwood timber areas. Some maple, beech, birch, and gumwood are used mainly for floors or trim. Poplar, cottonwood, and other kinds are used to a limited extent, principally for rough unfinished lumber in localities where the trees grow.

Commercial lumber is sold in three general classes: "dimension," "common board," and "finish." Besides these stock items many finished and semifinished wood products are used in housebuilding. Quality is stated by grade, according to uniform standards used in the lumber industry. Dimension and board lumber grades in general use are no. 1, no. 2 and no. 3 common. Finish grades vary and have numerous subdivisions of grade and quality, but primarily they are "clear," "select," and "common."

Dimension. Common lumber is cut to size or "dimension" in even-inch sizes, generally 2 inches thick and 2, 4, 6, 8, 10, and 12 inches wide. Although cut from the log at approximately full size the pieces are reduced in size by curing, and milling to a smooth or dressed surface. Dry finished 2-inch lumber is about 1⅝ inches thick. A "two-by-four" is actually 1⅝ inches by 3⅝ inches in size. For convenience and uniformity, standard lengths are 10, 12, 14, 16, 18, and 20 feet. It is possible to obtain longer lengths on special order, and some dealers handle 8- and 9-foot lengths and occasionally "short lengths." The principal use for dimension lumber is for framing. The grade may be either no. 1 or no. 2; at least the floor joists should be no. 1. Most commercial dimension is "kiln-dried" meaning that it is artificially dried under controlled conditions. Some lumber is air-dried for several months before it is used.

Common board lumber. Boards are cut from common lumber in stated sizes of 1 inch thick, even widths of 2 to 12 inches, and

even-foot lengths. Milling reduces the thickness to just slightly over ¾ inch, and widths are reduced in proportion. Boards are generally finished either with square edges, as shiplap with lapping edges, or as centermatch with tongued and grooved edges. Some manufacturers make end-matched boards so that both the ends and edges can be fitted tightly. Common boards are used horizontally on roof rafters under the roofing, either horizontally or diagonally on studding as wall sheathing, diagonally on joists to make subfloors, and in attics, basements, and other places where the finish is not important.

FINISH. The better qualities of lumber are made into "finish" for exposed surfaces, trim, and millwork. Common uses are for flooring, paneling, siding, door and window frames, and cabinets. Usually no. 1 common is the lowest grade used for finish; "clear" and "select" grades are preferable; or for some species finish is graded A, B, and C.

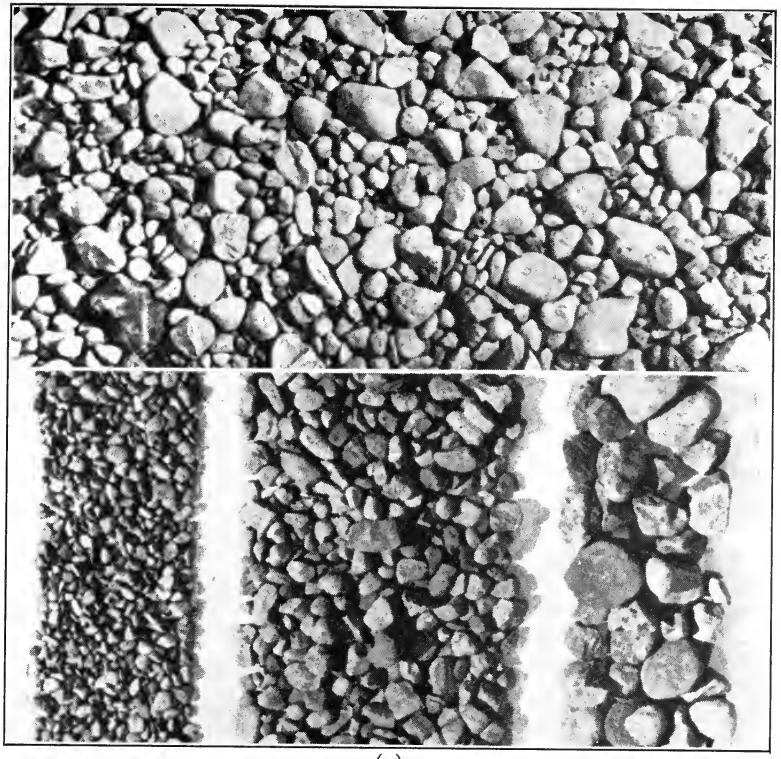
WOOD PRODUCTS. Wood is manufactured into finished materials such as cabinets, moldings, flooring, doors, and window frames. Flooring is tongued and grooved and sometimes end-matched, both in hardwood and softwood species. Moldings for trim are milled in various shapes for baseboard, quarter round, and other items.

PLYWOOD. Plywood is made by peeling thin layers of wood from logs and gluing them in layers to make sheets, usually 4 feet wide, and to 10 or more feet in length. The most common thickness is ¼ inch which is made of three layers. With additional plies, the material is made in greater thicknesses. If made with water-resistant or plastic binders, plywood withstands exposure and moisture and may be used for exterior surfaces.

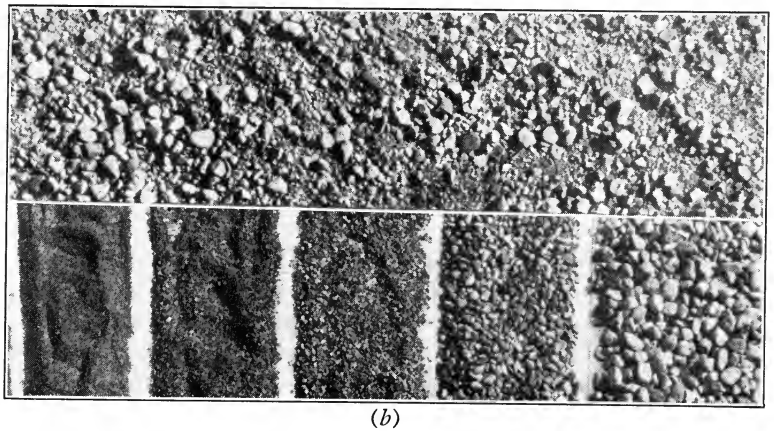
CONCRETE

Concrete is made by combining Portland* cement and water with sand and gravel or other hard ingredients. Cement is purchased in cloth bags or paper sacks containing approximately 1 cubic foot. Sand is composed of particles ¼ inch or less in diameter. Gravel or "coarse aggregate" ordinarily consists of

* "Portland" is the general name applied to cement used in making concrete, although it is sold under many brand names. The Portland Cement Association, 33 West Grand Ave., Chicago, Ill., supplies free booklets on many phases of making and using concrete.



(*a*)



(*b*)

Portland Cement Association

Figure 142. (*a*) Well-graded gravel for concrete (top), with particles separated to show varied sizes of particles. (*b*) Sand for concrete, before separation into sizes (top) and proportions of various sizes.

pebbles, ranging from ¼ to 1½ inches or more in diameter. Sometimes crushed rock, cinders, or commercial lightweight materials are used instead of gravel. If the coarse material is omitted, the cement and sand alone, or mixed with lime, produces cement mortar. Standard formulas prescribe the "water–cement" ratio or the amount of water used with each sack of cement to produce the required strength.

CAST-IN-PLACE CONCRETE. The quality of concrete depends on the proportions of cement to sand and coarse material and the amount of mixing water used. A typical "good quality" concrete is made by combining 1 part cement with 2¼ parts sand and 3 parts gravel. Approximately 5 to 5½ gallons of water are required per sack of cement, to produce a plastic mixture that is neither soupy nor crumbly. Each cubic yard or 27 cubic feet of concrete requires about 6 sacks of cement, ⅔ cubic yard of sand, and ¾ cubic yard of gravel.

Foundations, floors, walls, and other concrete structures are cast in place from freshly made concrete. Mixing is done at the site either by hand or by machines, or ready-mixed material is brought from a central mixing plant. It must be used within about 1 hour after mixing. Concrete hardens in the form into which it is poured and packed. Forms can be removed after a day or longer, depending on the weather. It is ready to use after about 1 week and reaches nearly full strength in 1 month.

CONCRETE MASONRY UNITS. The most common concrete unit is a building block, 8 by 8 by 16 inches. Blocks are widely used for exterior walls, basement walls, and partitions. Other concrete units include smaller blocks, bricks, tile, precast joists, and roof and floor slabs.

OTHER MASONRY

Brick, structural and decorative tile, mortar, and plaster are among the masonry items in general use. Common bricks are used for brickwork, which is hidden from view in the finished structure, and sometimes for exposed surfaces, either plain or painted. Face bricks are given a decorative surface in manufacturing to produce various color effects and textures.

Structural tile or hollow tile units are similar in composition to bricks but larger; a typical unit is 5 by 8 by 12 inches in size. Common grades are used in basement walls or as backing for

brick or stucco. Units having glazed, stippled, or other surface finishes are used for exterior walls. Decorative tile is used mainly for bathroom floors and walls, fireplaces and hearths.

Mortar for brick and structural tile is made with commercial mixtures combined with sand and water. Cement mortar is a mixture of 1 part of Portland cement to about 3 parts of sand and $\frac{1}{10}$ part of lime. Lime–cement mortar is made in proportions of 1 part lime, 1 part cement, and 6 parts sand. Plaster is made by mixing commercial plaster, usually a gypsum composition with sand or vermiculite and water, according to the manufacturer's directions.

Figure 143. Types of building sheets used in house construction: From top to bottom: hard panel, cement–asbestos, plywood, pressed fiberboard, rigid insulation board, gypsum board.

BUILDING SHEETS

Manufactured sheets are increasingly used in house construction to replace lath or both lath and plaster for inside surfaces, and in place of lumber for wall sheathing, siding, subfloors and roof decks. Each type of sheet has characteristics that make it suitable for one or more uses. Different materials, thicknesses, types, or surfaces are selected according to the need in each case. The following are among the most common:

Asbestos–cement. A hard durable composition of cement reinforced with asbestos fibers.

Gypsum board. A mineral mixture or plaster sheet, enclosed in a cardboard sheath.

Insulation board. Rigid sheets, made from wood fiber or other organic materials. Contain many small air cells, which give good insulation value compared to wood.

Panelboard. Sheets of compressed fibers or pulp to produce a relatively hard dense material.

Plywood. A wood product built up of layers of wood and glue or plastic binders.

Wallboard. A general term often applied to the foregoing sheets, but more specifically it refers to paper pulpboard.
Metal sheets. Both steel and aluminum sheets are used in housing, principally for roofing and siding.
Sandwich board. A combination of layers each having different characteristics, usually an insulating core, with asbestos–cement or other hard enclosing layers.

INSULATION

The insulation value of a material is determined by its capacity for retarding the passage of heat through it. All construction materials have this capacity to some extent. Very small air spaces combined with porous material, or enclosed between layers of tight material provide insulation value. Concrete, brick, and other masonry permit heat transfer at a much faster rate than wood. Materials such as mineral wool, granulated cork, or fibrous sheets give much better insulation than wood. For comparison, the insulation value or resistivity of wood is considered as having a value, or an index of 1.00. The common commercial insulation materials have values of from 2.50 to 5.00; that is, they range from 2.5 to 5 times the value of wood for each inch of thickness, in their capacity to retard the passage of heat. House insulation is manufactured in four common forms as follows:

1. Rigid sheets, or boards usually ranging from ½ to 2 inches thick. They are used as sheathing, inside-wall surfaces, attic linings, or as an extra layer in walls or ceilings.
2. Flexible insulation in the form of blankets or batts, usually having a paper layer on one or both sides. Thicknesses vary from about ½ to nearly 4 inches. The best use is for placing in spaces between rafters, joists, or studding.
3. Loose-fill insulation is granulated or loose material such as mineral-wool pellets, expanded mica or vermiculite, granulated cork, or other lightweight material. Loose-fill insulation may be blown or poured into wall spaces or between attic joists.
4. Foil insulation is a thin metallic sheet or bright metallic surface on paper or on enclosing layers of material. The insulation value is due to the capacity of bright surfaces to reflect heat waves.

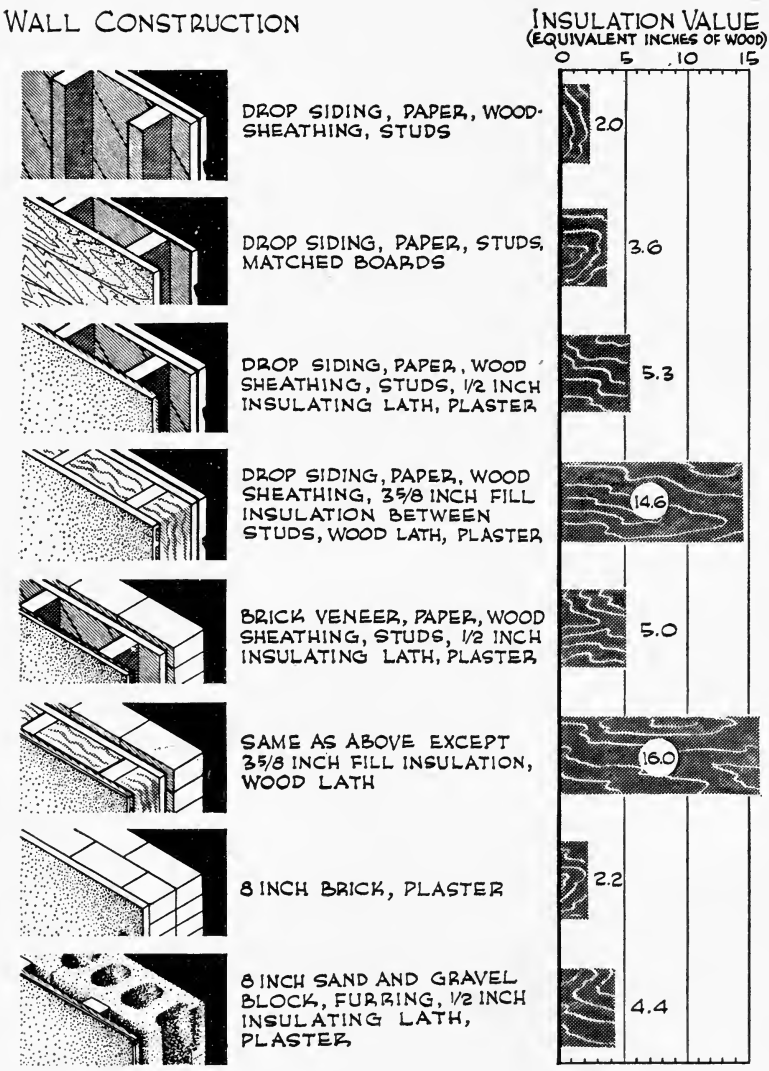

WALL CONSTRUCTION
INSULATION VALUE
(EQUIVALENT INCHES OF WOOD)
0
5
10
15
DROP SIDING, PAPER, WOOD SHEATHING, STUDS
2.0
DROP SIDING, PAPER, STUDS, MATCHED BOARDS
3.6
DROP SIDING, PAPER, WOOD SHEATHING, STUDS, 1/2 INCH INSULATING LATH, PLASTER
5.3
DROP SIDING, PAPER, WOOD SHEATHING, 3 5/8 INCH FILL INSULATION BETWEEN STUDS, WOOD LATH, PLASTER
14.6
BRICK VENEER, PAPER, WOOD SHEATHING, STUDS, 1/2 INCH INSULATING LATH, PLASTER
5.0
SAME AS ABOVE EXCEPT 3 5/8 INCH FILL INSULATION, WOOD LATH
16.0
8 INCH BRICK, PLASTER
2.2
8 INCH SAND AND GRAVEL BLOCK, FURRING, 1/2 INCH INSULATING LATH, PLASTER
4.4

Figure 144. Typical wall constructions and their relative insulating values.

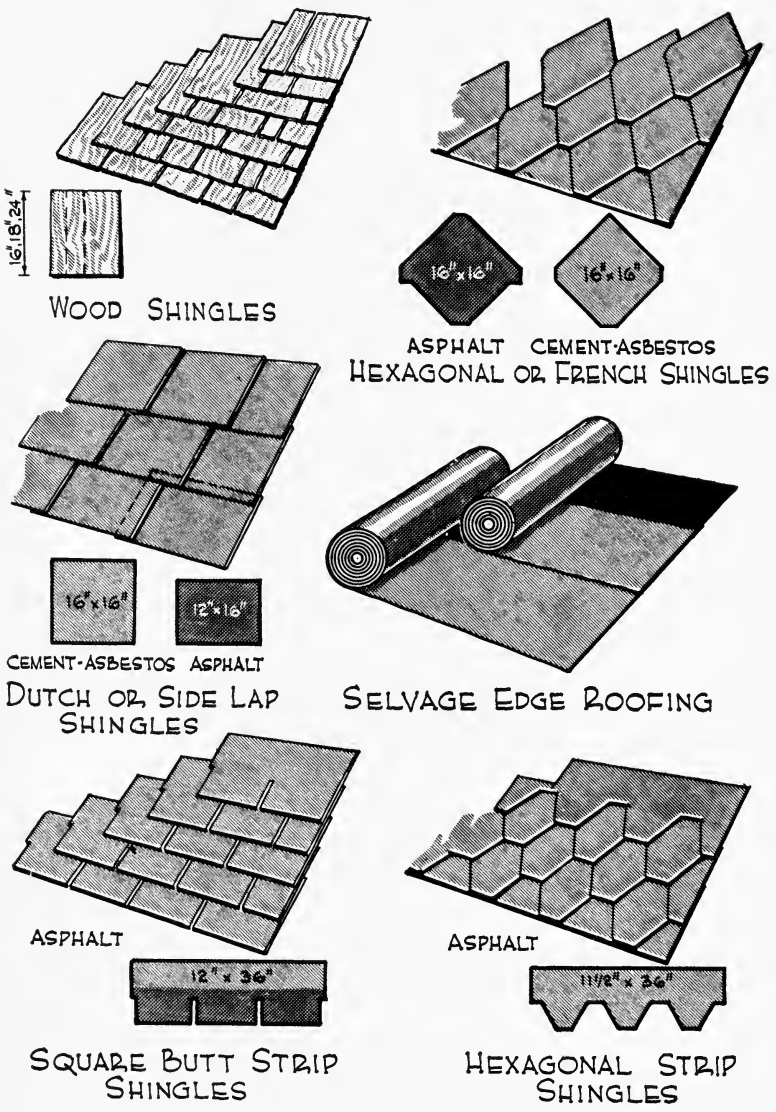


Figure 145. Commonly used types of roofing for houses.

ROOFING

Roof covering is measured by the "square" which is 100 square feet of surface. Choices depend on the quality, color, texture, and fire resistance desired. Very low-cost or temporary houses may be covered with asphalt roll roofing or corrugated steel sheets. Quarried slate and tile are seldom used except on very expensive houses, for both cost and weight prohibit their use at moderate price levels.

Most roofing materials are available in several grades, colors, textures, and shapes. Although other sizes, weights, and qualities may be used, the following are moderate in cost, widely distributed, and usually should be selected for the typical single-family house:

Wood shingles. No. 1, clear grade, western red cedar shingles in 18-inch lengths, to be laid with a 4- or 4½-inch exposure. Not classed as fire-resistant but acceptable in most areas if well nailed and maintained in good condition.

Asphalt shingles. Individual shingles should be laid to make three thicknesses on the roof to provide a weight of about 250 pounds per square. Or strip shingles weighing at least 200 pounds per square may be used instead. Fire-resistant but not fireproof.

Asbestos–cement. Hard rigid shingles which are fireproof. Preferably laid in Dutch-lap or American-method style.

Metal. Both sheet iron or steel and aluminum are used to some extent. Iron or steel should be 28 gage or heavier and galvanized for rust prevention. Aluminum has been used extensively only since 1946 for houses, and records of its durability are not available.

MISCELLANEOUS MATERIALS

Miscellaneous items are indicated and specified in the building plan: for example, anchor bolts, supporting posts, and fire linings. Other parts are clearly implied in the construction. Examples are nails, hinges, and glass. Some materials must be listed if they are to be used. These include building paper, screening, paint, floor finishes, and roof gutters.

Each of the miscellaneous items, although minor in cost or amount, may be especially important in construction. The quality

Lustron Corp.

Figure 146. Erection of metal prefabricated frame. Note metal frame, tie rods, electric conduit, windows, and panels.

selected may also affect the value of the house. For example, roofing nails for wood shingles should be galvanized, zinc-coated or otherwise made rust-resistant; common wire nails are not durable enough for this purpose. Cheap door hardware soon tarnishes and corrodes; solid brass or bronze metal is much more satisfactory.

Usually, three kinds of building paper are required: waterproof building paper on subfloors and sheathing; "vapor barrier" paper behind the plaster or wallboard; and roofer's felt under composition or asbestos–cement shingles. Screening for windows and doors varies from coarse-mesh painted wire, which is not adequate, to fine-mesh copper, galvanized wire, or plastic mesh, all of which are durable and long lasting.

Painting and decorating require a variety of materials that range from ready-mixed oil-base outside paints, to clear varnish, wax, enamels, and flat wall finishes for interior work. Each selection depends on the preferred quality, color, and finish, and on the kind of surface to be finished.

Owens-Illinois Glass Co.

Figure 147. Effective use of glass block panel for both light and decoration.

It is obvious that the student and the home owner cannot examine, compare, and select all items of this nature. Yet it is important to be able to recognize values if there is opportunity to choose from dealer's stocks or to discuss details with the builder, dealer, consultant, or architect.

CHAPTER 15

Costs and Material Quantities

The cost of a house is a question of primary interest to the family, and yet it is most difficult to answer in advance of construction. Costs are so variable that forecasts can serve only as general

Weyerhaeuser Sales Co.

Figure 148. Modest cost is achieved in this house by simple lines, small size, and absence of expensive detail.

guides. Even for this purpose, estimates may reflect "wishful thinking" or prejudices in favor of a particular material or method.

Published cost estimates for houses illustrated in magazines or books are not reliable for general use, nor exact enough for all

sections of the country. If a wide cost range is given, as "from $7,000 to $15,000," then the figures are of little or no value. The wage and price situation and other factors differ from one locality to another and vary from year to year.

It is possible, of course, to obtain reasonably exact estimates by taking account of materials, prices, wages, local conditions,

Pittsburgh Plate Glass Co.

Figure 149. This interior with many desirable features is an example of a relatively high cost level.

standards of quality, and a knowledge of the house plan. This means that estimates must be made by someone who knows how to calculate costs. Current prices and expense factors must be used and made to apply to a given location.

At best, some cost items cannot be predicted exactly. There is always a possibility that reductions may be made as a result of efficient operation, good weather, bargain purchases, or other savings. It is also likely that cost might go up on account of delays, unexpected price rises, or oversight in listing some items.

Experienced contractors know about what their costs will be. But even when several bids are submitted for the same work, variations occur in estimates. Contract proposals often vary by 10 per cent, or more, above or below the average. Large-scale

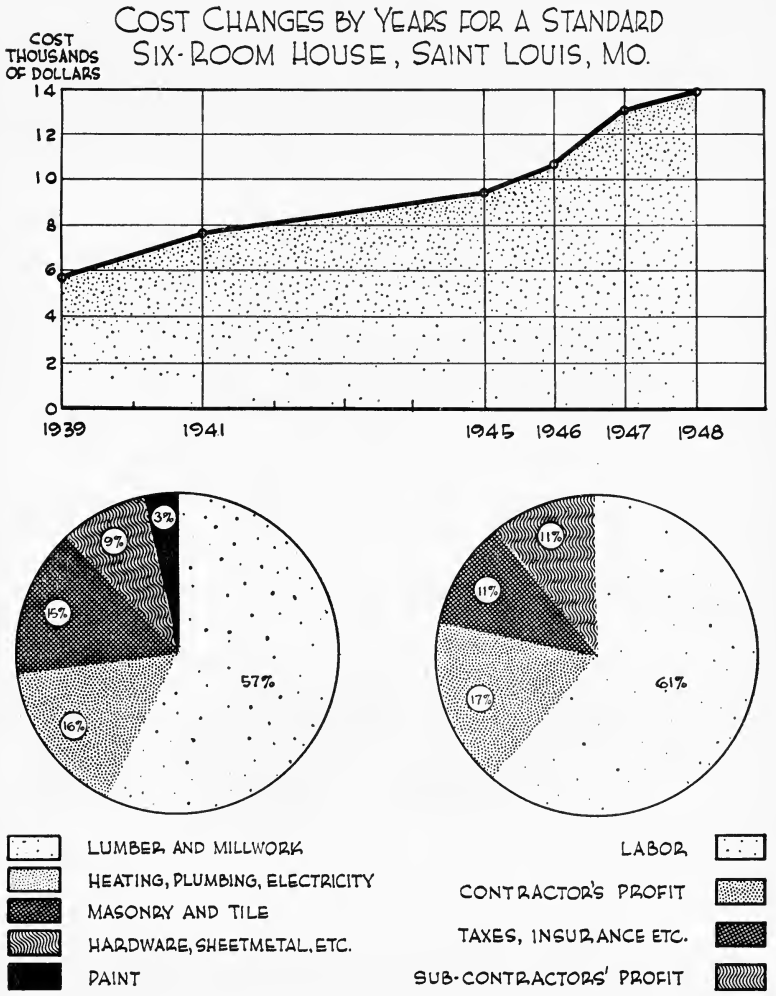


Figure 150. Cost variation by years, and principal items making up the cost of a typical house. See Table 4.

TABLE 4. BUILDING COSTS OF A STANDARD SIX-ROOM FRAME HOUSE BUILT IN ST. LOUIS

Cost of Materials	1939	1941 Oct.	1945 Oct.	1946 Oct.	1947 Oct.	1948 Apr.
Masonry	$513	$514	$603	$644	$709	$735
Tile work	103	159	175	175	214	258
Unfinished lumber	360	544	695	723	986	1,045
Finished lumber	660	861	1,117	1,134	1,668	1,713
Millwork	513	689	702	837	1,087	1,112
Heating	239	262	273	330	409	504
Plumbing	277	289	320	383	432	501
Sheet metal	49	106	56	59	114	117
Electric work	27	34	50	70	76	76
Nails and hardware	64	80	79	81	134	139
Painting	29	35	36	43	173	197
Misc. metal and wood	192	227	246	263	315	357
Total material cost	3,026	3,800	4,354	4,732	6,317	6,754
Labor cost (on site)	1,696	2,279	3,177	3,685	4,178	4,394
Overhead—profit of subcontractors	344	433	515	586	701	757
General contractor's profit	505	650	805	900	1,120	1,191
Sales taxes, insurance, bond	323	424	553	629	758	798
Total cost	$5,894	$7,586	$9,404	$10,582	$13,074	$13,894

This table used by special permission of Roy Wenzlick & Co., copyright owner.

builders must be able to determine costs to a rather high degree of accuracy in order to set a price on houses to be built for sale.

Estimates may be precise calculations such as would be used by contractors, or they may be approximations if only a general cost level is required. Methods of estimating are discussed later; it is necessary first to understand the factors that influence cost and the conditions that tend toward higher or lower costs.

HOW COSTS VARY

House costs go up and down as high and low points occur in general economic and business trends. On the whole, costs have increased rather steadily for many years. Housing values that cost $1.00 in 1910 increased to about $1.75 by 1930, and $2.00 by 1940. Table 4 shows the cost variations for a typical 6-room

frame house in St. Louis, Mo. during 10 years from 1939 to 1948. Comparable increases occurred throughout the United States. The table provides an interesting comparison of the various items making up the total cost. Materials account for about half the cost; the rest is made up of profits, overhead, taxes, and wages.

Costs are affected also by the demand for housing, ease of obtaining credit, and such factors as local codes, regulations, and construction requirements. Costs are increased by employers' liability expense, insurance, unemployment compensation, social security taxes, and transportation of material and employees. Houses cost less in mild-weather areas because they do not require the same insulation, heating plants, and weather protection that houses do in the North.

Other factors being equal, costs vary almost directly with the size of the house, the amount of equipment used, and specifications calling for high- or low-cost materials. The following list compares the principal factors that tend to increase or reduce costs:

Costs are relatively *higher:*	Costs are usually *lower:*
1. In larger urban centers.	1. In villages and on farms.
2. In northern regions of the United States.	2. In southern regions.
3. In spring and summer.	3. In fall and winter.
4. When materials are shipped in.	4. Near the source of materials.
5. If delivery is difficult.	5. If delivery requires a short haul.
6. In "prosperous" times.	6. During depressions.
7. If it is easy to borrow funds.	7. If credit is difficult to obtain.
8. If there is little competition.	8. If competition is keen.
9. If plan and structure are complex.	9. If simple standard construction is used.
10. When highest quality materials are used.	10. If lower-priced materials are used.
11. If new housing is in demand.	11. If the demand is slack.
12. When there is a lack of planning.	12. If houses are carefully planned.
13. If individual wants are a principal factor.	13. If standard materials and practices are accepted.
14. When much hand work is involved.	14. If volume production methods are used.

Some of the factors listed have more weight than others; or one may offset another. For example, the normally higher costs in urban areas may be balanced by better efficiency made possible through building many houses in one community. Lower wages

generally prevail in rural areas, but transportation costs or hand labor methods may increase the total cost.

WAYS TO REDUCE COSTS

Lack of ability to pay for good housing is a major obstacle in the way of housing improvement for many families. Any method of reducing cost will, therefore, aid in attaining better housing. Regardless of the limits of one's income, it is desirable to obtain the best value for the money spent. If money can be saved in construction, more can be spent for furnishings, appliances, or other things that appeal to the family and give personal satisfaction. As costs increase and new values are offered in housing, prospective owners must either spend more, modify their demands, or find ways to reduce total cost. It is often possible to save on cash outlay by using one or more of the following methods:

1. Eliminate nonessential or less desirable features or those which do not affect livability; these may include fireplace, porches, finished attic, or "extra" rooms.
2. Defer some things that can be added later, such as wall decoration, basement finish, and some appliances.
3. Use standard doors, windows, millwork, trim, and cabinets. They usually cost less than special design.
4. Utilize materials and methods that are known to be the least expensive for the locality; for example, adobe in the Southwest, native lumber in timbered areas, and stone where it occurs naturally in the locality.
5. Choose less than the highest grades of material. Frequently, it is possible to obtain roughsawed lumber, bank-run gravel, cull brick, and common grades of lumber. These cost less and do not reduce the durability of the house if properly selected and used.
6. Utilize "home" labor for excavating, grading, hauling material, mixing concrete, or helping with other parts of the construction. Many men have the ability to do much of the work on medium- and low-cost houses. A few can build their own houses.
7. Select the time, season, and construction method to obtain the more economical cost.

COST GUIDES

Labor and materials make up most of the cost of building a house. The total cost usually also includes architect's service; builder's profits; general expense for transportation, insurance, social security payments, and so on, fees for building permit, inspections, and deposits for service connections. Site cost including lot, utilities, grading, landscaping, sidewalk, and perhaps other

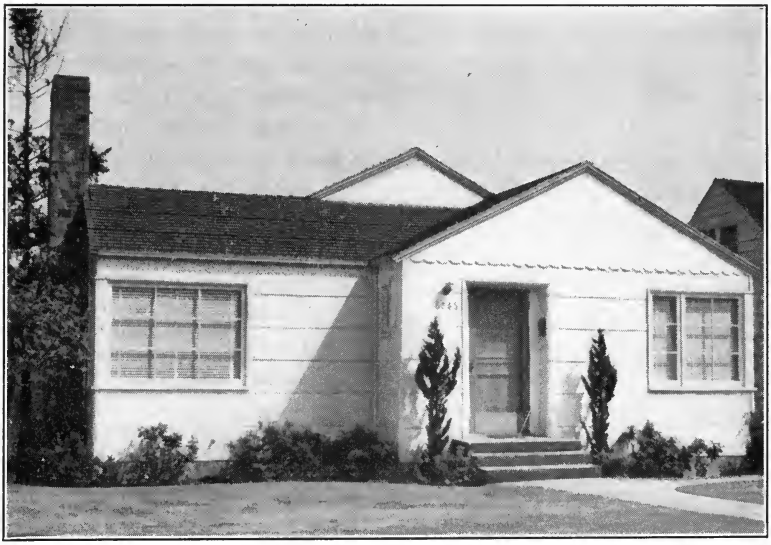


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Figure 151. Another example of moderate cost housing which embodies attractive features of design.

features are part of the total property cost. Accessories such as stove, refrigerator, and window shades are sometimes included.

Since costs are stated in various ways, it is necessary to distinguish among: (1) labor and material cost only, (2) the total building cost excluding the lot, and (3) the entire property cost of house and lot. Building costs are generally assumed to include all labor and material and the "overhead" consisting of taxes, fees, and profit; the cost of the site is not a construction cost.

One should recognize the various kinds of estimates or statements of cost which follow and their relative exactness:

CLASS ESTIMATE. Generally, houses in any community can be

divided roughly into class levels according to typical value. For example, before World War II typical cost ranges were from $3,000 to $8,000, generally grouped at $1,000 intervals. In 1948, costs were at least twice as high. These general price levels can be determined for the locality and used as a preliminary guide in planning.

Approximate forecasts. Houses of a given type or quality vary in cost principally according to size. With local information on current costs, estimates can be made on the basis of the area of floor space, the cubic volume, or, in a general way, the number of rooms in the house.

Calculated costs. A reasonably exact calculation can be made by a skilled estimator, given a set of plans, specifications, and information on location, prices, and wages. Quantities of material are determined by listing the amounts from the plan. Labor is estimated in several ways: (1) from handbook data on normal capacities per hour or per day for such work as framing, bricklaying, and plastering, (2) by using information based on local experience, or (3) by using fixed rates for specific jobs, like sanding floors, finishing concrete, building flues, painting, and installing wiring. Labor for house building accounts for about 50 per cent of the combined labor and materials cost. Thus, if the materials are listed and priced, which can be done rather exactly, the materials cost may be doubled to give both labor and material. To this total, it is necessary to add: (1) Sales tax, delivery charges, social security taxes, liability and risk insurance, (2) contractor's service and profit which may be 10 to 25 per cent of other costs, and (3) permits, inspections, sewer, water, gas and light connections, and architect's fee, if included.

Contractor's bid. When a contractor submits a bid for building, remodeling, repairing, installing equipment, or other service, he is responsible for estimating and guaranteeing the costs involved and included in his contract proposal. In some cases, bids are made on the basis of actual cost plus a fee or a percentage to the contractor. Then the owner must assume the responsibility for all costs, regardless of whether or not an estimate had been made.

Selling price. If a house is sold after it is completed, the cost to the purchaser is established by negotiation; there is no need for the owner to concern himself with calculations except as he may wish to have an estimate made for his own information.

The stated price includes the lot and other improvements as well as the house itself.

OTHER COST INFORMATION. The reliability of estimates depends largely on the responsibility involved. For example, a contractor's bid is a guaranteed offer to provide the house for the price quoted. An estimator or architect can be depended on to furnish a reliable estimate although it may not be guaranteed. Although approximations are useful general guides, offhand statements of probable cost cannot be relied on.

A good way to find out what a new house is likely to cost is to compare prices of similar houses built recently in the community. Owners and contractors generally do not care to discuss the cost of a house unless it is offered for sale. On the other hand, architects, real estate agents, dealers, appraisers, contractors, and lending agents know local property values. Usually, they are willing to discuss current home building costs. Building permits issued by inspectors in towns and cities are published or are available for examination. The permit lists only the estimated construction cost: to determine the total, add architect's or contractor's fees, site cost, and subcontracts for plumbing, wiring, heating, and other utilities.

APPROXIMATE COST ESTIMATES

From information gained by experience or obtained by consulting builders, dealers, and architects in the community, it is possible to apply unit costs to obtain a reasonably close approximation. The units commonly used are "per room," "per square foot," and "per cubic foot." If average or typical room sizes are assumed, it makes little difference which unit is used. The cubic-foot volume calculation gives the more exact measure of relative size, since ceiling heights, and closet, bathroom, and hall space are taken into account.

BY NUMBER OF ROOMS. Count the rooms used for living, dining, sleeping, and working. Do not count hallways, bath, attic, or basement. The typical 1948 cost for average quality well-equipped houses in many parts of the United States was about $2,000 per room. On this basis 5-, 6- and 7-room houses would come in the general cost ranges of $10,000, $12,000, and $14,000, respectively.

BY SQUARE FEET OF FLOOR SPACE. Because room sizes are variable, a calculation based on floor space is generally a better measure

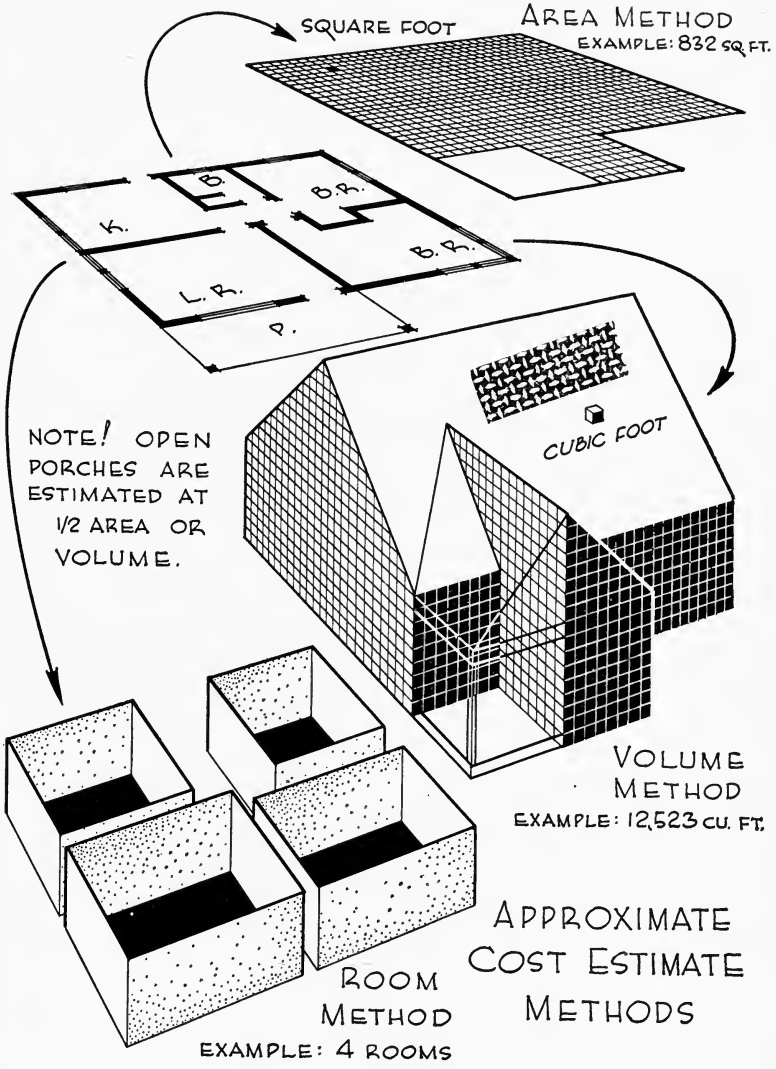


Figure 152. This diagram illustrates the room, area, and volume calculation for estimating costs.

of cost than the number of rooms. Typical 6-room houses might have floor areas varying from 1,400 to 1,600 square feet. At an assumed square foot cost of $8, the estimate would be between $11,200 and $12,800; at $10 a square foot, the cost estimate would be $14,000 to $16,000.

By cubic feet of volume. The cubic-foot calculation includes the entire volume of the house—basement and attic as well as the finished part. Thus, it most nearly measures the relative size of one house compared to that of another. To find volume, multiply the floor area, or the ground area, by the height measured from the basement floorline to the average roof height or mid-point between attic floor and ridge. If the house is irregular in outline, figure each section separately. If there is no basement, measure up from the ground line. A 6-room house of a common size contains about 20,000 cubic feet. The 1948 cubic foot unit cost in many localities was 75 cents, which would give $15,000 as the estimate. Construction costs in 1948 were higher than in any previous year and were from two to three times the 1936–40 average. A wide range occurs in different localities and from one year to another. To be valid for the community, estimates must be based on local wage scales, material costs, taxes, and other overhead costs.

MAKING PRECISE ESTIMATES

Skill and experience are necessary to make cost calculations based on plans, specifications of grades and qualities, available materials, and current prices. Detailed discussion cannot be included in this book. On the other hand, enough study is needed to obtain a good understanding of methods, for the family is often concerned with the cost of flooring a room, reroofing the house, adding insulation, or purchasing materials.

In preparing estimates for a new house, it is necessary to have plans drawn to scale, which show measurements, sizes of material, dimension of parts, and the number and size of openings. One should know the kind of finishes, types of utilities, and the amount of cabinet work, shelving, and trim. Specifications should define grades and qualities.

It is necessary to be familiar with stocks of materials, sources of utilities and supplies, prevailing prices, and wage scales. Paint stores, plumbing shops, electrical contractors, and other agencies

can supply facts needed for a careful cost analysis. Estimates should be made in about the same order as construction is done, beginning with excavation, foundation and masonry, and continuing with framing, enclosing layers, roofing, utilities, and finishes.

The materials needed for a house, or for any specific job are listed as a "bill of materials," also called the "material list" or "quantity survey." Each list should give enough information to indicate the number of items or pieces, and sizes, lengths, grades, or such other facts needed to fill an order. It is best to list materials in terms of common units–pounds, board feet, sacks, or pieces, as the case may be, so that prices can be quoted.

In order to calculate amounts and prepare estimates it is necessary to know: (1) what materials are needed and the units by which they are sold, (2) how to figure each item, and (3) how to measure quantities from a plan or for a specific purpose. The following discussion covers these three points.

COMMON MATERIALS AND UNITS. Construction materials may be grouped into classes such as masonry, lumber, millwork and finish, metal, hardware, insulation, utilities, and paint. Within each class, subdivisions may be made to include as much detail as may be needed. Masonry includes cast-in-place concrete, concrete masonry units, brick, various kinds of tile, plaster, and mortar. Some items must be listed to show the ingredients. For example, concrete is made up of cement, sand, and gravel, each being bought separately. The usual materials and purchase units are given in the following list:

Brick. Common, face, fire, and special. Specify grade, hardness, color, texture, and finish, as necessary to identify. Unit: 1,000 or 100.

Cement. Ordinary gray Portland cement is the most common. Specify paper or cloth sacks. White cement and Keene's cement are for special purpose. Unit: sack (for large-scale work: barrel, equal to 4 sacks).

Concrete. Sometimes bought ready-mixed, but usually the separate ingredients are bought. Unit: cubic yard.

Concrete blocks. Usually 8 by 8 by 16 inches made from cement, sand, and gravel. Some are made with cinders or lightweight ingredients instead of gravel. Unit: pieces.

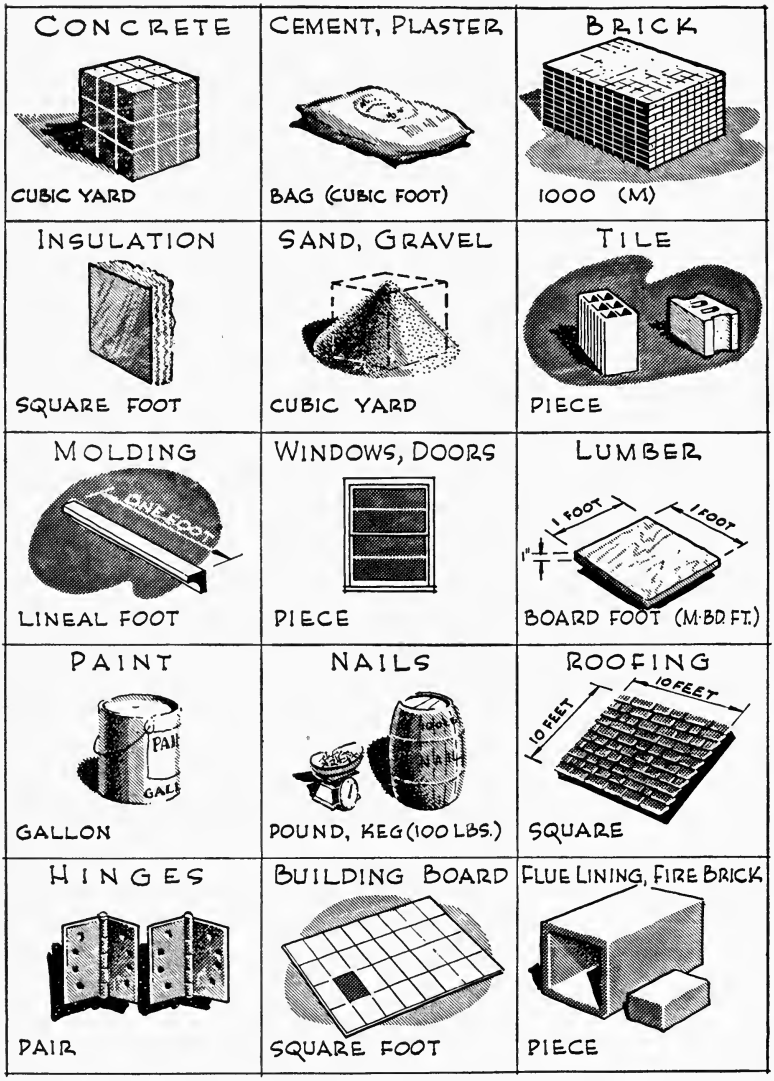


Figure 153. Common commercial units by which materials are purchased.

Gravel. Clean, hard gravel, pebbles or crushed rock, ¼ inch and larger. Bank-run gravel, graded from fine to coarse, is sometimes used instead of separated sand and gravel. Particles graded from ¼-inch and smaller are sand. Unit: cubic yard.
Insulation. Choice of board, batt, blanket, or loose fill of various materials. Specify type, thickness, and size of sheets or batts. Unit: square foot.
Lumber. In "boards" up to 1 inch thick, "dimension" usually 2-inch thickness, and "finish" as selected. Specify species, grade, and other characteristics such as rough or dressed, plain or matched. Flooring, siding, and wood ceiling are included in lumber list. Unit: board foot, or 100, or 1,000 board feet.
Millwork. Includes frames, trims, molding, doors, windows, screens, cabinets, and other items. Usually choose standard patterns and specify by catalog number and description. Units: pieces, or for some items, linear feet.
Nails. Usually common wire nails in various types and sizes. Types are made especially for flooring, roofing, finish, sheet metal, and so on. Unit: pound, or 100-pound keg.
Paint. Wide range of choice in color, price, and quality. Includes house paint, wall finish, enamel, varnish, floor seal, and others. Unit: gallon.
Plaster. Usually gypsum plaster, although other kinds are available for special uses. Unit: sack.
Roofing. Many kinds, such as asbestos–cement, asphalt, wood and metal shingles, asphalt and metal sheets, sometimes tile and slate. Specify color, shape, weight, or other distinguishing feature. Unit: square, which is 100 square feet.
Sheet materials. Plywood, asbestos-cement, gypsum, insulation board, pulpboard, hard fiber panelboard, and metal. Select according to use, and specify thickness, length, coating, and details that describe the item. Unit: square foot.
Structural clay products. Usually 5 by 8 by 12 inch hollow tile, terracotta flue lining, exterior (facing) tile. Unit: 1,000; for flue lining, the unit is linear feet.
Utilities. Generally selected and contract let for both materials and installation. Unit: the entire installation. For electric wiring the unit is number of openings.

It is not necessary for a builder or home owner to make detailed and exact calculations for many items used in building. Only small amounts and costs are involved for nails, bolts, screws, hinges, and miscellaneous items. They can be bought by the pound, dozen, keg, box, or carton as needed. Wiring, plumbing, and heating contractors base their estimates on amounts of material normally required per opening or unit of radiation, or duct work. Dealers or contractors can quickly verify the amounts of paint, wallpaper, plaster, insulation, and such special items. The owner need only provide the measurements of areas to be covered. Manufacturers or suppliers determine the materials making up stairs, doors, windows, or cabinets, which are sold as complete units. The estimate list gives only numbers, sizes, and types.

By omitting the complex details just noted, the calculation of quantities becomes a simple process of listing numbers of items, areas of surface, volumes of masonry, and pieces of framework. These measures can be converted into the required number of units. The examples which follow show how to calculate the three most common classes of material: (1) masonry, (2) enclosing layers such as sheathing, paneling, roofing, and insulation, and (3) framing.

MASONRY. Materials are determined by the volume of brick or concrete masonry or by surface area where a single thickness of brick or blocks is used. Volume is determined in cubic feet found by length multiplied by width, multiplied by depth or thickness. It requires 22 bricks for a cubic foot of brick masonry. A "perch" of stone fills 16⅔ cubic feet. Ready-mixed concrete is sold by the cubic yard. A typical formula for concrete requires 6 sacks of cement, ⅔ cubic yard of sand, and ¾ cubic yard of gravel for a cubic yard of concrete. Each 100 square feet of wall, one layer thick, requires 750 bricks, 250 structural clay tile (5 by 8 by 12 inches laid flat), or 112 concrete blocks, size 8 by 8 by 16 inches.

ENCLOSING LAYERS. Materials are calculated on the basis of area to be covered. Roofing is estimated by "squares" of 100 square feet each. Find the surface area in square feet, and divide by 100 to find the number.

Plaster is calculated by the square yard. Find the square feet of surface to be covered by multiplying length by height of all walls to be plastered, without deducting for doors and windows.

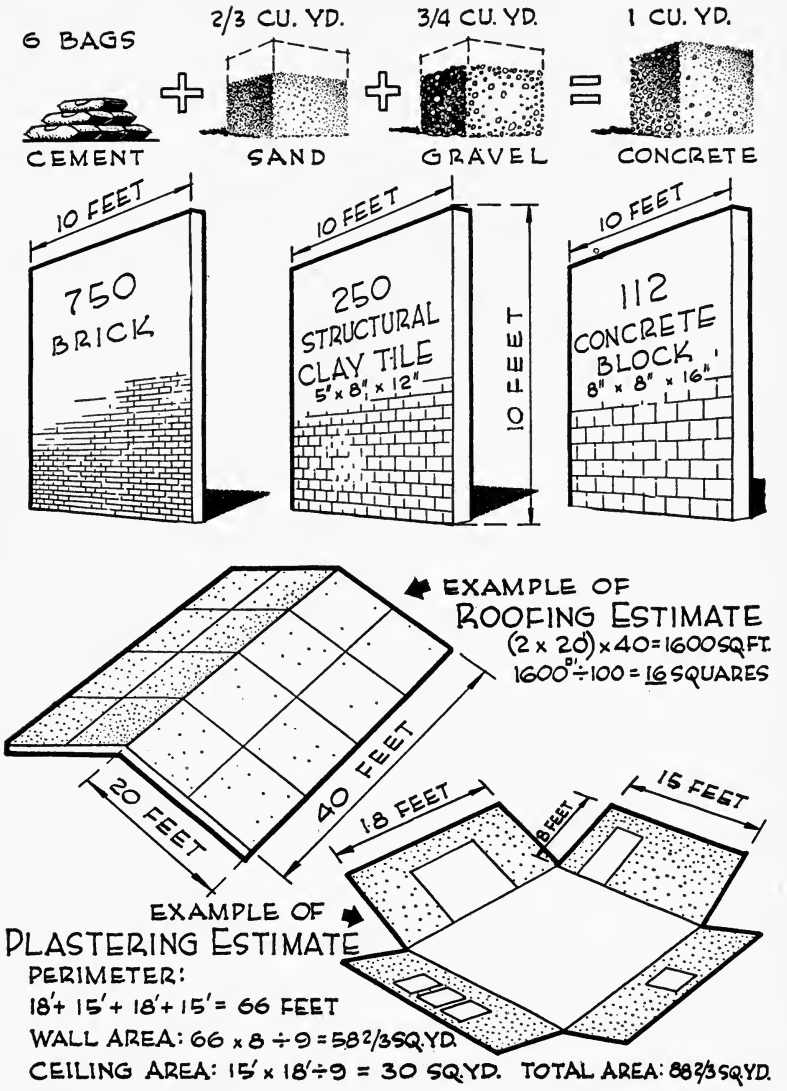


Figure 154. Methods of calculation for various material items.

Also add the ceiling areas. Convert square feet to square yards by dividing by 9.

Building sheets of all types are priced in units of area, either per square foot or per 1,000 square feet; therefore, the amount is calculated in square feet of area to be covered.

Lumber for sheathing, decking, subfloors, finish floors, and siding is sold by board measure. A board foot is defined as a square foot of lumber 1 inch thick (or less) symbolized by a board 1 inch thick, 12 inches wide, and 1 foot long. This is an assumed measurement rather than real, however, for shrinkage in curing and dressing reduces both the thickness and the width of boards. Overlapping of edges in matched lumber further lowers the covering capacity. The narrower the boards, the greater the loss due to matching. Some waste in cutting and fitting always occurs during construction.

To allow for "underrun" or shrinkage, waste and matching, and to obtain enough material to cover a given surface, it is necessary to buy more board feet than there are square feet in the surface. A practical solution is to determine the area and add a fraction of the area to find the number board feet needed. This fraction is ⅓ for 3-inch material, ¼ for 4-inch, ⅙ for 6-inch, and ⅛ for 8-inch boards.

For example, assume a room 12 by 20 feet, having 240 square feet of floor. If the subfloor is to be 1-by-6-inch boards, the amount needed would be 240 (the area), plus ⅙ of 240, or 40 (for waste and matching), or 280 *board feet*. If the finished surface is to be 1-by-3-inch flooring, one third would have to be added to the area; therefore, 320 board feet would be needed.

Framing or dimension lumber. The dimension lumber needed is figured in pieces, sizes, and lengths. The amounts are then converted to equivalent board feet. To obtain an answer in board-foot units, it is necessary to divide inches of width by 12. Thus, the basic calculation for 1 board foot would be: 1 (thickness) $\times$ 12 (width) $\times$ 1 (length) $\div$ 12 (inches in 1 foot of width) = 1 board foot. The same procedure can be used for lumber of any thickness by dividing the cross-sectional area (in inches) by 12. A 1-foot length of 2- by 6-inch lumber is figured as follows:

$$\frac{2 \times 6}{12} \times 1 = 1$$

board foot. A general statement, substituting symbols for figures in the basic calculation, provides a workable formula. If T is used for thickness, W for width, and L for length of piece, the formula would be

$$\frac{T \times W}{12} \times L = \text{board feet or } BM \text{ (board measure)}$$

For any quantity, it is only necessary to multiply by the number of pieces, N. The complete formula may then be stated as

$$\frac{T \times W \times L \times N}{12} = \text{board feet}$$

The formula can be applied to any combination of number and size of pieces; the result is always in board-foot units. For example, a stack of 12-foot, 2-inch, by 8-inch dimension, containing 24 pieces is figured as follows:

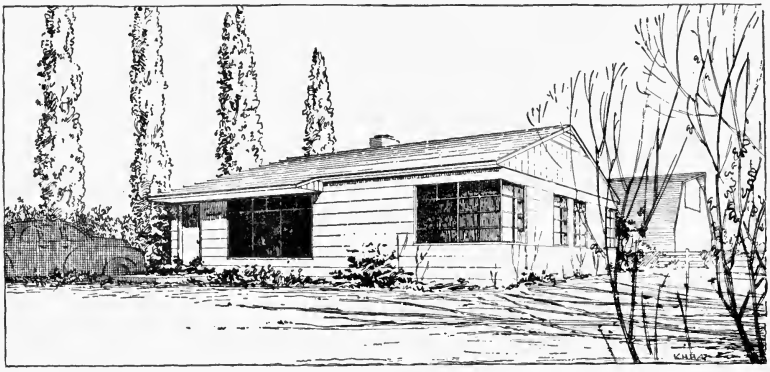
$$\frac{2 \times 8 \times 12 \times 24}{12} = 384 \text{ board feet}$$

LISTING MATERIALS FROM PLANS

The methods outlined for calculating amounts can be applied directly to find the materials needed for any house. See Table 5 and the accompanying illustrations for a typical example. It is best to study the plan and become familiar with its principal features before any materials are listed. The area of the house is used several times in the calculation and usually is the same for basement floor, subfloor, finish floor, ceiling materials in each story, overhead insulation, and attic flooring. The perimeter or distance around is used to calculate footings, foundation wall, sills, plates, wall sheathing, and siding. Ceiling heights are needed to estimate wall surfaces and lengths of uprights. Other measurements once determined may be needed several times for making calculations.

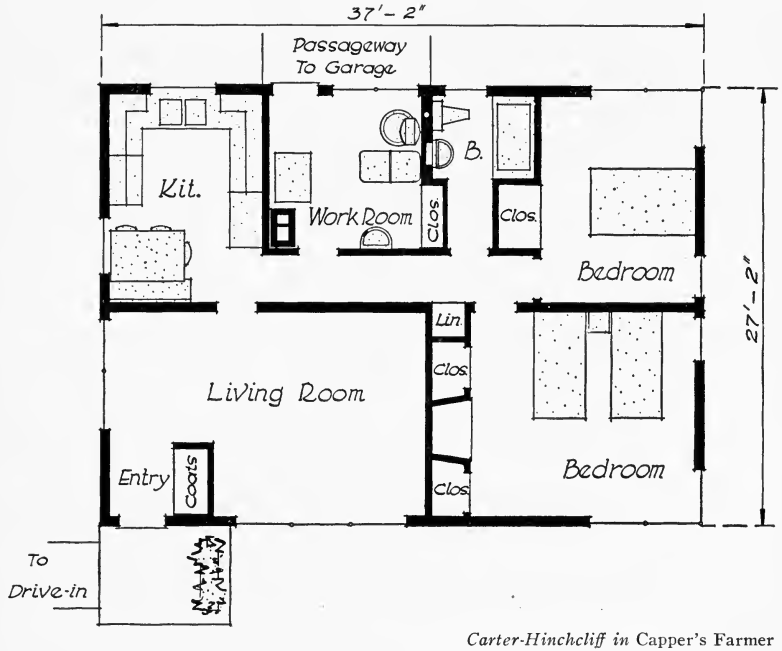
The following suggestions indicate the usual practice in listing materials:

1. Count items that will be purchased as units or awarded as subcontracts. Principally these include doors, windows, cabinets, stairs, plumbing fixtures, electrical openings, and screens.



Carter-Hinchcliff in Capper's Farmer

Figure 155. Perspective of small modular farmhouse design. Floor plan shown in Figure 156.



Carter-Hinchcliff in Capper's Farmer

Figure 156. Compact farmhouse plan. Material list given in Table 5.

Table 5. Material List of Principal Items and Quantities

For the 1-Story Farmhouse, (Figures 155 and 156)	
Brick, common for flue	1,200
Flue lining, 8″ x 12″	40 lin ft
Concrete materials: Cement	100 sacks
Sand	11 cu yd
Gravel	13 cu yd
Steel girder 6-inch I beam	37 lin ft
Termite shield	140 lin ft
Anchor bolts ½ x 16 inch	2 dozen
Building paper: Waterproof	1,700 sq ft
Vapor barrier	1,700 sq ft
Roofing felt	1,400 sq ft
Insulation: Overhead, 3½ inch	1,000 sq ft
Sidewall, blanket, or fill	700 sq ft
Inside wall and ceiling finish, plaster or other type	400 sq yd
or	3,600 sq ft
Siding, exterior, any type	900 sq ft
Roofing	14 squares
Ridge roll or finish	38 lin ft
Sheathing, wall	1,200 sq ft
Sheathing, roof, solid (or 972 for wood shingles)	1,620 bd ft
Subfloor, matched boards	1,160 bd ft
Finish flooring, 1″ x 3″ or 1″ x 4″	1,300 bd ft
Bridging, 1″ x 3″ pieces	224 lin ft
Framing lumber	
Sill, 165 lin ft 2″ x 6″	165 bd ft
Floor joists, 58 pcs 2″ x 10″ 14 ft	1,354 bd ft
Base plate, 270 lin ft 2″ x 4″	180 bd ft
Wall plate, 540 lin ft 2″ x 4″	360 bd ft
Wall studs, 270 pcs 2″ x 4″ 8 ft	1,440 bd ft
Gable end studs, 12 pcs 2″ x 4″ 12 ft	96 bd ft
Ceiling joists, 58 pcs 2″ x 6″ 14 ft	812 bd ft
Rafters: 15 pcs 2″ x 6″ 18 ft	270 bd ft
43 pcs 2″ x 6″ 16 ft	688 bd ft
Lintels, 120 lin ft 2″ x 12″	240 bd ft
Ridge, 36 lin ft 2″ x 6″	36 bd ft
Miscellaneous ties, braces, etc.	120 bd ft

2. Measure linear feet for molded or single pieces, such as picture mold, baseboard, quarter-round, railings, ridge piece, eave spouts, and gutters.

3. Determine areas for all surfaces to be enclosed or covered with sheathing, roofing, siding, flooring, insulation, building paper, or plaster. Convert areas to square yards, squares, or board feet, as necessary to indicate purchase units.

4. Find the total volume for each class of masonry or areas for single walls of brick or blocks.
5. Do not detail nails, screws, bolts, and other standard small items, but obtain them as needed.
6. Consult suppliers or contractors for quantities needed for the areas to be covered with such materials as paint, wallpaper, and linoleum.
7. List dimension or framing materials. List by linear feet for parts made up of continuous construction, like wood posts, sills, plates, and braces. Determine size and number of pieces for all parts having specified lengths, as, for example, the joists, studs, rafters, and minor items of framing. Add about one tenth to the calculated number of pieces as "extras," to allow for some framing pieces to overlap, pieces for corners and around openings, and some inevitable waste and breakage. Convert all items or groups of similar items to board feet.
8. Note that a complete estimate includes many additional details, for example, excavation, drains, scaffolding, utilities connections, and house sewer.

CHAPTER 16

Economic and Financing Problems

For most families the standard of housing is limited by their income, whether they own or rent. Relatively few can select housing without regard to cost. Among low-income families, good housing is often impossible, for many do not have savings or income sufficient to invest in a home. Even among families with moderate and good income, day-by-day expenses must be met and a reserve accumulated before ownership is possible.

HOW MUCH TO INVEST

A study of one's own situation and resources is better than a fixed rule to determine how much can be afforded for a house. More can be spent by families who put a high value on a home compared to other things. A well-established family can invest more than a family not yet permanently settled.

Perhaps the best guide is the family budget, which determines how much could be set aside each month for housing. The monthly amount that could be used to invest in a house multiplied by 100, gives the approximate total that could be safely spent. Another guide is that a family with a regular income can spend the equivalent of 2 to 2½ years income for a house.

To illustrate, a family has an income of $300 a month or $3,600 a year; and a budget that allows $75 to be set aside each month for housing. One hundred times the monthly amount of $75 is $7,500. Twice the annual income is $7,200, and 2½ times the income is $9,000. Thus the indicated range is between $7,200 and $9,000 as the probable amount that might be invested with safety.

WHAT RENT PAYS FOR

Under normal conditions, monthly rent should not exceed 1 per cent of the value of a house. For example, an $8,000 house should

rent for not more than $80; from $65 to $75 is more nearly a normal rent. Fuel, utilities, and the value of appliances are not usually included in the rent for a single-family house. When one is renting rooms or apartments, it is important to know what services and privileges are included, such as use of the laundry, appliances, and parking space; entertainment of guests, and "house rules" that must be observed.

Rental rates may be by the day, week, or month; houses are usually rented by the month. If no formal agreement is made, it may be assumed that the house is rented on a month-to-month basis. Then it is customary to give at least 30 days notice before leaving. Likewise landlords must give due notice before a tenant can be evicted. From 30 to 60 days notice is required, depending on local custom. More time is allowed under some conditions where a hardship would result from eviction.

Generally a lease is preferable to month-to-month renting as a protection to both landlord and tenant. Leases run for one year or longer and may be extended by renewal or agreement.

THE COST OF OWNING

The rent one pays is clear evidence of housing cost. It takes about one fifth of the average family's income. The cost of owning a home is not as apparent but just as real, for the owner must pay taxes, insurance, and repair bills. Even if the house is free from debt, the interest on the investment must be counted as an item of cost. A house depreciates with age or becomes obsolete over the years, and the decline in value represents a cost to the owner.

The cost of owning a house should be clearly distinguished from the cost of buying or building (see Chapter 15). The "cost of owning" is the amount one pays directly or indirectly each year. It depends partly on the value of the house, for most of the annual costs vary in proportion to the investment. Estimating the cost of ownership is important in planning in order to anticipate expenses and to compare costs of owning or renting. Two kinds of expenses are involved; cash for bills which must be paid each year, and "use costs" consisting of depreciation, and interest forfeited because money is "tied up" in the house. Following are the items that make up the annual cost of ownership:

Taxes. Real estate is taxed to cover part of the expense of state and local government. Rates are established locally and

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Figure 157. Ownership of an attractive home is a desirable goal, if the family's resources permit.

differ in each area. Information on local rates can be obtained from county officials.

Special assessments. Benefit payments are assessed for improvements such as water lines, sewers, sidewalks, and streets. Usually, annual payments are required; they are relatively high until the improvement cost is paid out; then smaller assessments may be made to maintain services and utilities. Assessments are relatively lower in thickly settled areas where costs are distributed over many properties. Sometimes the improvements in a suburb or community are paid for by the developer and charged in the selling price.

Insurance. Insurance should be carried for protection against loss from fire, wind, hail, lightning, and explosion. Rates differ with the class of property, kind of construction, available fire protection, hazards, and zoning. Insurance agents have rate

schedules that apply to each case. Annual policies can be obtained, but it is more economical to take out a policy covering a 3- or 5-year period.

Repair and maintenance. This item is variable, ranging from minor or emergency repairs, to expenses for redecoration, outside painting, and roof repair or replacement. Repair costs increase as the building becomes older. Regular maintenance prolongs the useful life of the house. Cheap construction may require excessive upkeep, while high quality tends to reduce yearly repair and maintenance expense.

Depreciation. Even well-maintained houses decline in value as a result of exposure and use and become less desirable as styles change and newer more modern houses are built in the community. The wearing-out period may vary from 30 years for relatively cheap houses up to 60 years or even longer for well-built well-kept houses. As a basis for figuring costs it is generally assumed that 40 years is the useful life of a typical wood-frame house.

Interest. If the money invested in a house were available for loaning out at interest, or for buying bonds, it would pay a cash return. It is logical, therefore, to assume that the interest value should be charged as a part of the cost of owning.

ESTIMATING ANNUAL COST

If it is assumed that a house will last 40 years, then 2½ per cent of the value is used up each year. Interest on real estate investments is from 4 to 5 per cent a year, and so the owner should count interest at this rate in figuring his house cost. As a house depreciates, however, the owner has a smaller value each year on which to compute interest so that over a long period the annual interest charge will be only about 2½ per cent of the first cost. The combined cost of interest and depreciation thus amounts to about 5 per cent of the house value. Taxes, insurance, and assessments can be determined locally for any house. An estimate of 2½ per cent of the house value may be taken as typical for these items. Repairs vary from year to year but will normally average 1½ per cent. The total is 9 per cent, or $9 a year for each $100 in value. The calculated annual cost of owning a $10,000 house thus amounts to $900 a year, or $75 a month.

FINANCING

Buying a house requires more than most families have in ready cash and available savings. It is necessary to borrow a portion of the money needed and repay the loan over a period of years. Borrowing to buy a home is distinctly different from short-time borrowing for personal needs, or for the purchase of nondurable goods, automobiles, or household items and furnishings. Installment buying and repayment of short-time loans is relatively expensive; often the interest rate is very high compared to the cost of house financing.

Housing loans are made by building and loan associations, insurance companies, banks, trust companies, and individuals. Such loans are highly favored, since they provide an effective way for the owner to finance a home and a safe investment for the lender. Under modern methods of financing, loans are commonly made for two thirds to three fourths of the value of the property. Insured loan plans make it possible to finance up to 90 per cent of the cost.

In the past it has often been difficult to arrange safe low-cost housing loans on favorable terms. Large-scale investors could not deal directly with many individuals, and people with small sums to invest did not have facilities to make and manage loans. Most prospective home owners did not have the resources to demand the most favorable terms. As a result, high interest rates, short-term loans, fees for renewing loans, second mortgages, and high initial payments increased costs and often hindered effective financing.

These disadvantages have been overcome by two home financing plans which assure safety for the investor and economy and convenience for the borrower. They are (1) Federal Housing Administration (FHA) insured loans and (2) building and loan association direct-reduction loans. The majority of loans for home financing are made under one or the other of these systems. Interest rates and terms of repayment are about the same under either plan. Similar policies are also commonly followed by other lending agencies. Guaranteed loans for war veterans are similar to other housing loans and are financed by the same agencies. A smaller down payment is needed, as a portion of the veteran's loan is guaranteed by the Federal Government, based on inspection and approval by a representative of the Veterans Administration.

FHA LOANS

Money borrowed for home financing under the FHA plan comes from banks, building and loan associations, trust companies, and other lending agencies. Arrangements for the loan and security are made between the borrower and the lending institution. Government participation, which is the essential feature of the plan, requires that a representative of the Public Housing Administration shall: (1) approve the application for the loan, (2) investigate the credit standing of the borrower and his ability to pay, (3) examine the property, and approve or disapprove sites and plans, (5) require adherence to minimum specifications, (6) set the maximum amount of the loan, and (7) inspect the house during construction. The owner pays a fee for these services. Interest rates and terms of repayment are prescribed by law, and the lender is guaranteed against loss. A small percentage fee is added to the interest rate to pay for this guaranteed loan feature.

The value of the FHA plan is that lenders are attracted by the guarantee of repayment, which justifies them in accepting a minimum rate of interest; currently 4½ or 5 per cent. The borrower has the advantages of the low rate, a relatively small down payment, a long-term loan if needed, and the inspection and approval services. Detailed information about FHA loans and requirements for approval may be obtained from state or local offices of the Housing and Home Finance agency of the Public Housing Administration or from any approved mortgagee that makes such loans.

BUILDING AND LOAN ASSOCIATIONS

Building and loan associations are nonprofit co-operative organizations which operate under state and Federal regulations. They provide both a means of saving and a method of financing. Although the associations are not sponsored by the Federal Government, many of them are members of the Federal Deposit Insurance Corporation which guarantees investors against loss up to $5,000.

Generally, building and loan association funds are obtained by the sale of certificates or installment stock to local investors. Loans for housing are then made within the community, often to individuals who own stock in the association. Officers and

managers are familiar with conditions in the area; they know local values and the borrower's credit standing. Borrowers are encouraged to make the loan period as short as possible, within their ability to pay. Typical loans are repaid in from 8 to 15 years.

FARM CREDIT

Urban loan plans, such as FHA and building and loan are not well adapted for farmhouse financing. Farmers' incomes may be seasonal and irregular. Security involves all or part of the farm, for the house has no important sale value apart from the land. It is better, therefore, to finance farmhouses through Federal Land Banks or private agencies specializing in farm loans and to arrange annual or semiannual payments. Where credit is not otherwise available, the Farmer's Home Administration may be utilized for obtaining loans.

LOANS AND SECURITY

If short-time loans are needed, money can be borrowed for periods of 1 to 3 years without giving a mortgage on the property. Most banks and other lenders make such loans directly or under the provisions of the FHA. Loans for buying or building are generally made for longer terms of 5 to 20 or more years. They require a mortgage as security by which the property is pledged to guarantee repayment. A mortgage is given by the borrower to the lender. When the terms of the loan have been met and the money repaid, the mortgage is canceled. If the owner fails to keep up the payments, the creditor may foreclose the mortgage, and the property must be sold to satisfy the debt. If the "forced" sale brings more than the amount due, the owner receives the balance after costs are deducted. If the sale is for less than the amount due, the lender may in some cases obtain a "deficiency judgment" and collect the balance from other resources the borrower may have.

REPAYMENT

Once a loan is made, it is necessary to follow a definite program for repayment. If careful planning has been done and good judgment used up to this point, payments can be made without hard-

ship. The down payment gives the owner a "stake" in the property and an incentive to save. Monthly payments may amount to no more than rent.

Repayment may be on any basis agreed on such as a single sum or payments each quarter or at semiannual or annual periods. By far the most common plan is to make payments in monthly installments. Reducing a debt gradually by regular payments is called "amortization." Payments include the interest due to date and an added amount to be applied to reduce the principal. Monthly payments may be increased enough to cover insurance, taxes, and special assessments as well as the amount due on the loan. Loan agreements should permit the borrower to pay extra amounts at any payment date so as to save interest and clear the debt sooner.

The following example illustrates how the amortization plan operates:

1. Assume that a $1,000 loan is made for a term of 12 years at 5 per cent interest.
2. The agreement provides for monthly payments of $9.25 to be made until the loan has been paid.
3. Interest on $1,000 at 5 per cent would be $50 annually, which is equivalent to $4.17 the first month.
4. In the second month the principal is $994.92 since $5.08 has now been paid off. Interest at 5 per cent amounts to $4.14 for the second month, leaving $5.11 of the $9.25 payment to apply on the principal.
5. In the third month the remaining principal sum is $989.81. In this and each succeeding month, interest is calculated on the decreasing principal. Thus, the interest gradually decreases, and more of the $9.25 monthly payment is available to reduce the principal.

The foregoing example shows how a loan is steadily reduced by a payment made each month. Amortization tables may be used to determine the amount credited to principal and interest at each payment date. Long-term loans require smaller monthly payments than short-term loans, but a larger part of the total amount paid is for interest. Table 6 indicates the way a loan of $1,000 at 5 per cent is amortized by monthly payments including interest in

12 years. The division of amounts applied to interest and principal are detailed for the first 12 payments, then by years. Table 7 illustrates the reduction of a $1,000 loan when smaller payments are made over a longer period. In this case interest is figured at 4 per cent per year, which is $3.33 for the first month.

TABLE 6. AMORTIZATION SCHEDULE—5 PER CENT, 12 YEARS

For repayment of a $1,000 loan at 5 per cent interest in 12 years, with a payment of $9.25 per month

Month	Amount for Interest	Applied on Principal	Balance due on Principal
First	$4.17	$5.08	$994.92
Second	4.14	5.11	989.81
Third	4.12	5.13	984.68
Fourth	4.10	5.15	979.53
Fifth	4.08	5.17	974.36
Sixth	4.06	5.19	969.17
Seventh	4.04	5.21	963.96
Eighth	4.02	5.23	958.73
Ninth	3.99	5.26	953.17
Tenth	3.97	5.28	947.89
Eleventh	3.95	5.30	942.59
Twelfth	3.93	5.32	937.27
Year	(Interest decreases each month, and amount applied to principal increases for the entire period of the loan.)		
Second			$870.00
Third			800.00
Fourth			727.50
Fifth			652.50
Sixth			572.50
Seventh			491.25
Eighth			402.50
Ninth			307.50
Tenth			209.53
Eleventh			106.79
Twelfth			Paid out

TABLE 7. AMORTIZATION SCHEDULE—4 PER CENT, 18 YEARS

For repayment of a $1,000 loan at 4 per cent interest in 18 years, with a payment of $6.50 per month

Month	Amount for Interest	Applied on Principal	Balance due on Principal
First	$3.33	$3.17	$996.83
Second	3.32	3.18	993.65
Third	3.31	3.19	990.46
Fourth	3.30	3.20	987.26
Fifth	3.29	3.21	984.05
Sixth	3.28	3.22	980.83
Seventh	3.27	3.23	977.60
Eighth	3.26	3.24	974.36
Ninth	3.25	3.25	971.11
Tenth	3.24	3.26	967.85
Eleventh	3.23	3.27	964.58
Twelfth	3.21	3.29	961.29

In the second and succeeding years, the interest decreases as the principal is reduced, and an increasing amount is applied to the reduction of the debt. Extra amounts paid at any time reduce the capital sum and shorten the total period of the loan.

CHAPTER 17

Acquiring Home Ownership

Owning a home is the goal of the majority of families. If the family is established and the outlook is for reasonably permanent residence in the community, it is highly desirable to plan to build or buy. It may be necessary for the young family to wait a few years before assuming the cost and risk that is involved. Teachers, ministers, or others whose work requires them to move about, usually do not wish to invest in a home. Some publicly owned housing is provided and company houses are used for staffs or employees, for example, at military posts or in mining and lumbering areas.

It may not be feasible to own a house in some places if apartments are available and factors of cost, transportation, and distance from work are considered. Or a family may prefer to rent to avoid the obligations of ownership. Many families never acquire enough money to pay for a home.

Nevertheless, about one half of all families in the United States own their homes, and more have been home owners at some time in the past or will be in the future. Each family must weigh the advantages and disadvantages and decide between saving for a home or using its money for other purposes.

Many points must be considered in comparing arguments in favor of renting and of owning. The decision may be based on such personal grounds as the ease or difficulty of finding a suitable house to rent, the permanence of one's work, and the satisfaction taken in owning a home. Yearly cost is a minor consideration in the long run. Renting takes somewhat more cash, because the landlord must make profit to cover vacancies and other risks. Owning involves expense for upkeep, taxes, insurance, repairs, interest on the investment, and depreciation in house value. These

costs either for renting or owning balance rather closely; however, the owner has the advantage in that he gradually acquires a debt-free property.

Acquiring a home, whether by buying or building is an important step and may affect the happiness, welfare, and security of the family. It is often a "once-in-a-lifetime" problem; relatively few families buy and sell often enough to be familiar with the details involved. People often buy homes with less thought than might be given to the buying of an automobile. Yet important obligations are involved, and a debt may be incurred that will not be paid off for 15 or 20 years. Disappointment in the future can be largely avoided by considering present resources, probable future incomes, housing costs, and the payments necessary to clear the debt. One should also determine what might be done if it becomes necessary to move away or if, for some other reason, the house might have to be sold.

The decision to become an owner should be made with full knowledge of the resources needed, the risks and the obligations involved. One should know about the different ways of obtaining a house, the business and legal aspects, costs and methods of financing, and details of judging quality and value. Some of these points have been discussed in preceding chapters. In this chapter the step-by-step considerations are outlined.

RESOURCES THAT JUSTIFY OWNERSHIP

Financial resources and regular income must be sufficient to justify building or buying. Food, clothing, education, automobile, savings, and insurance usually take much of the current income. Before a home can be purchased the family should have:

1. A reserve or savings for a "down payment," which should be equivalent to one fifth to one third of the proposed housing investment. Under some conditions, insured loans for new housing can be obtained if the owner puts in 10 per cent of the estimated value as his initial payment.
2. Enough income to make regular payments on the loan so it can be paid off within 12 to 20 years. Generally, the amount required each month, to pay taxes, insurance, interest on the debt, and a payment on the principal should not be more than one fifth of the monthly salary.

3. Several hundred dollars readily available for immediate costs, such as buying insurance on the house, moving, laying floor coverings, obtaining window shades, and meeting miscellaneous expenses.

RISKS AND ADVANTAGES

If a home is bought when prices are high, it may be impossible to sell later without taking a loss. If prices drop severely, it may not even be possible to sell at a fair price or to make payments, and the house may be lost by foreclosure. An expensive house may require so much for repairs, maintenance, and payments on the debt as to become a burden on the family, unless the income is also high. Hardships resulting from the 1930–34 depression caused many people to lose their homes. It was necessary for the Government to establish the Home Owner's Loan Corporation to refinance loans and defer payments or arrange terms that could be met. In contrast, houses bought between 1930 and 1941 increased greatly in price during and immediately after World War II.

Owning has some advantages and values compared to renting that offset the risks of ownership:

1. The owner will be more permanently located without the possibility of being evicted at the will of a landlord or when the lease expires.
2. Changes or improvements may be made when the owner wants them.
3. Outlay for upkeep and improvement need not be made regularly; expenditures can be made at favorable times or at least deferred for a while if necessary.
4. The obligation to make regular payments compels thrift and brings added security.
5. The equity in the property increases as payments are made on the debt. When the house is paid for, the owner has more reserves than if he had been paying rent.
6. There is a social value and a permanent satisfaction in owning a home, if it is financed in a way that keeps payments and expenses from becoming a burden.

CONTACTS TO MAKE WHEN BUYING

Buying a home or a homesite requires contact with numerous individuals, organizations, agencies, and services. Others may be consulted for advice and helpful information. Although the prospective owner is free to buy and sell, choose his plans, and make independent decisions (except for legal restrictions), it is always advisable to consult with others and, where possible, employ professional service. The principal contacts include the following:

Real estate agents. Agents know current prices, have a choice of properties for sale, and are able to arrange the many details of a sale. Fees are ordinarily paid by the seller.

Lending agents. Financing agencies are glad to advise home buyers, not only in making loans but also as a service to prospective owners.

Suppliers. Manufacturers, dealers, and trade associations supply information as a part of their trade promotion and to assure the best utilization of their materials or products. They have the newest facts about prices, products, and improved methods.

Contractors. Building contractors and equipment installers are familiar with costs, trends, and values in the local building field. They usually provide free service for their customers in estimating costs, submitting bids, and determining equipment requirements.

Consultants. Various services may be needed which are not a part of the free service connected with contracts or purchases. Such service should be obtained from the following professional people: (*a*) *attorneys* to prepare or give opinions on legal papers, (*b*) *surveyors* to locate property lines or verify established lines, (*c*) *abstractors* who check court records and prepare abstracts for titles, (*d*) *architects* who may be employed only to prepare plans or to make plans and supervise the entire work, and (*e*) *advisers* or *consultants* who may be engaged for general services or special work, such as buying material, inspecting work in progress, preparing estimates, or appraising property values.

Public service agencies. Helpful aids are free or available at

nominal cost from city building inspectors, city engineers, public utility representatives, and state and Federal workers concerned with housing and building. Services may include publications such as codes, zoning laws, maps, construction standards, bulletins, and general information on financing, planning, or building.

WAYS TO ACQUIRE OWNERSHIP

Most home owners buy their houses already built. A relatively few build new houses according to their own plans. But in either case similar problems are involved. Except for gift or inheritance, a home is acquired by one of the following methods:

Outright purchase. The house and site are bought from the owner. Payment is made in full, or a down payment is made, and financing is arranged for the remainder. The transfer is made by a "deed," so that the new owner has full possession, subject to whatever mortgage is required to secure a loan. Subdivision developers or building contractors often sell a specified house at a fixed price and give possession when the house is finished; sometimes the purchaser has the privilege of deciding on colors, finishes, cabinets, and other features.

Contract purchase. The buyer agrees and signs a contract to pay a small initial sum, which is not sufficient as a down payment to obtain a title. He makes regular payments until a substantial amount has been built up. Then the title is transferred as in the case of outright purchase.

Construction contract. A site is bought, plans obtained and arrangements made with a contractor to build the house and furnish the services necessary to complete the improvement according to the contract.

Owner's supervision. The owner may wish to take all the responsibility for building his house. He buys the lot, arranges for plans, buys materials, hires labor, and directs the work. He may award partial or subcontracts for some of the work, services, and installation of equipment. Some men are experienced enough to do part of the construction; a few build their own houses, with some help on work requiring special skill.

LEGAL STEPS IN ACQUIRING OWNERSHIP

Costly and irritating delays, misunderstandings, and lawsuits may be caused by failure to follow the essential steps in buying and selling.

The title to real property rests in a plot or tract of land. The land may be listed as a unit of a platted area or subdivision officially mapped and recorded in the county court. Or it may be described by location based on the public survey used in the area. (Generally the survey is by ranges, townships, sections, and fractions of square-mile sections down to 40-acre areas.) Unless the boundaries are clearly evident, either by inspection or official plats, it may be necessary to have a survey made by the county surveyor or other licensed surveyor.

Title is transferred from seller to buyer by means of a deed—usually a "warranty" deed that guarantees a clear title. The title is not clear until the property is free of overdue taxes, mortgages, or other obligations. The county court records list all previous transfers, claims, or encumbrances. To expedite buying and selling, all records pertaining to any one property are summarized or abstracted by qualified and authorized "abstractors." The resulting "abstract of title" is essential evidence of ownership. It is provided by the seller.

The average buyer is not familiar with the legal details of deeds, abstracts, surveys, or other papers involved. Someone experienced in real estate transfers should be employed; it is best to obtain the services of a lawyer to examine the papers. The final step to legal ownership is to have the deed recorded in the county court.

In summary, the buyer should obtain: (1) deed, (2) abstract, (3) survey, and (4) lawyer's examination of the papers. Then he must record the deed as his legal evidence of ownership.

THE BUSINESS OF BUILDING

The choice of methods of arranging for the construction of a new house depends largely on the responsibility the owner wants to assume. He can award a contract covering the complete job, or he may direct all the work himself. The usual types of contracts are discussed briefly:

General contract. Under this arrangement one contractor is awarded the entire work. Then it becomes a "turnkey" or

completely finished job, to be done according to plans, specifications, and details that outline and define everything to be included. The general contract is based on a fixed amount of money as agreed on; the contractor takes the entire responsibility, and cannot claim additional payments except for "extras" requested by the owner or included by mutual consent. In periods when business conditions are stable and normal competition exists, it is good practice for the owner or his architect to obtain several bids and award the work to the lowest responsible bidder.

Cost plus a fee. When building activity is at a high level, or when materials are scarce and costs are uncertain, it may be necessary to disregard competition and guarantee the builder a fee or profit on the work. This is done by a "cost plus" contract. The contractor provides all materials, labor, and other services. The owner pays these costs and, in addition, pays the contractor a fee, which may be a specified sum or a percentage, usually between 10 and 20 per cent of the cost.

If the owner does not wish to award a general contract, he may act as his own contractor. He must then obtain insurance and permits, comply with codes and regulations, and arrange for inspections. He may award separate contracts or "subcontracts" for utilities, services, and equipment. Labor is hired and material purchased. In some cases the owner employs a superintendent to direct work.

CONTRACT DOCUMENTS. A written agreement should be made to detail the responsibilities and terms of payment for all work done by contract. It should cover duties and responsibilities, plans, specifications, prices, and terms. Contracts should be in writing so that each party knows definitely what is involved. Some changes are unavoidable; they should be agreed to in writing and a fair price adjustment made. A "give and take" attitude generally results in a fair settlement. The usual documents include:

Contract. This is a written agreement, signed by owner and contractor, which embodies the offer and its acceptance for the work to be done, and the terms and conditions agreed to. Architects and contractors generally use standard contract forms and standard agreements on the "general conditions."

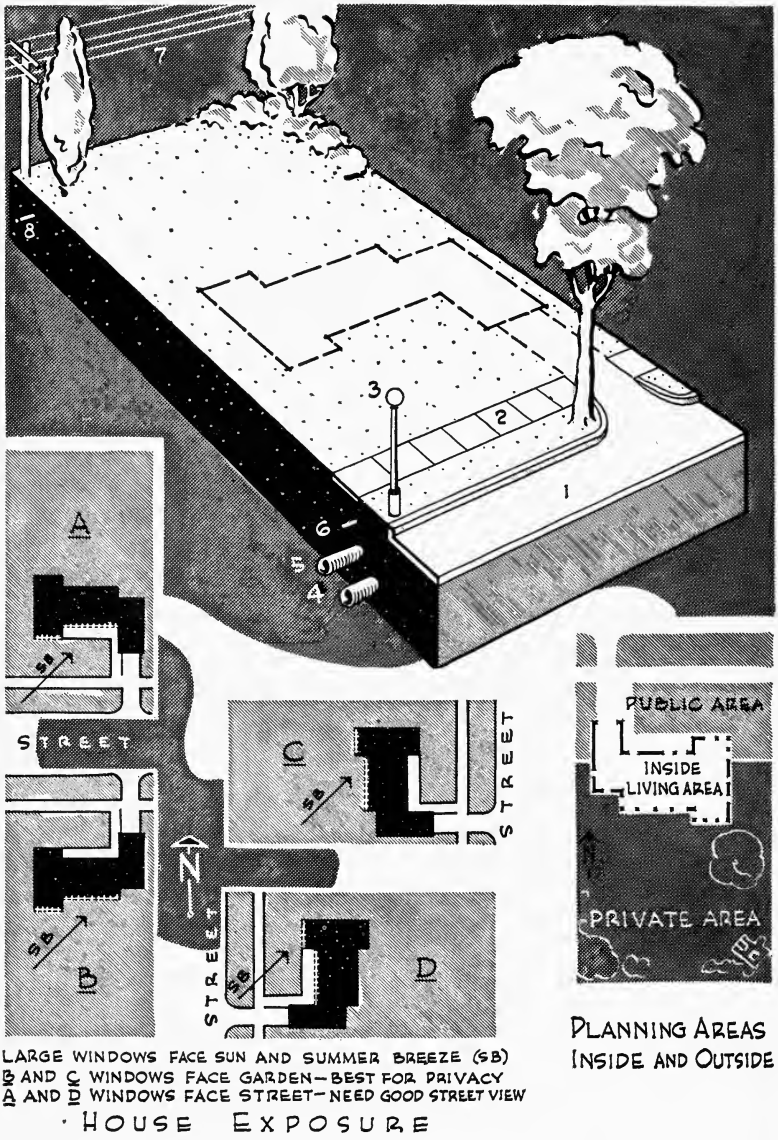

Figure 158. Selecting a homesite involves a study of the facing, use of the land area, available utilities and possibilities for landscaping. Numbers refer to: (1) pavement, (2) sidewalk, (3) lights, (4) sanitary sewer, (5) storm sewer, (6) water, (7) electricity, (8) gas.

General conditions of the contract. This is a complete statement of the duties, privileges, and responsibilities of all parties concerned with the work. A standard statement is accepted nationally by architects and contractors, as a definition of contract practices, and serves as a basis for settlement in case of misunderstanding.

Performance bond. Contractors on public work are required to give bond to guarantee fulfillment of contracts. A bond is always required on large-scale operations, but not generally on small jobs when dealing with established organizations. The owner may require a bond, but he will be expected to pay for it.

Plans. Plans consist of drawings with enough detail to clearly indicate the work to be done. The more complex the work, the greater the detail necessary. Plans and specifications are essential on house construction to enable builders to figure costs closely, avoid uncertainty, prevent substitutions or substandard practices, and provide all interested parties with the same information. They are especially important in general contracts where a fixed price is made.

Specifications. These are written statements to describe grades, qualities, workmanship, and methods of procedure.

SELECTING A SITE

Sometimes a single factor may outweigh all other considerations in finding a location. The selection may be limited to one neighborhood for personal reasons or because of nearness to work, convenient transportation, good schools, or near-by churches. If cost is a factor, a choice may have to be made between an expensive site in a completely developed location, and a lower-priced lot having fewer attractions.

Unless the prospective buyer is familiar with the community, it is desirable to study the area, community, and neighborhood; compare advantages and disadvantages of possible locations, and talk to owners, agents, businessmen, and others. In this way it is possible to get a good idea of current prices, values, probable future trends, and possible unsatisfactory conditions. After the questions of location and cost ranges have been settled, the following specific factors should be considered:

Land cost. Generally the lot should not cost more than 20 per cent of the estimated cost of the house.

Improvements. In urban areas, it is necessary to have access to electricity, water, and sewer facilities. Sidewalks, paving, street lighting, storm sewers, gas lines, and fire and police protection are desirable. If all these are obtained, the cost will be higher, and more taxes will have to be paid than where

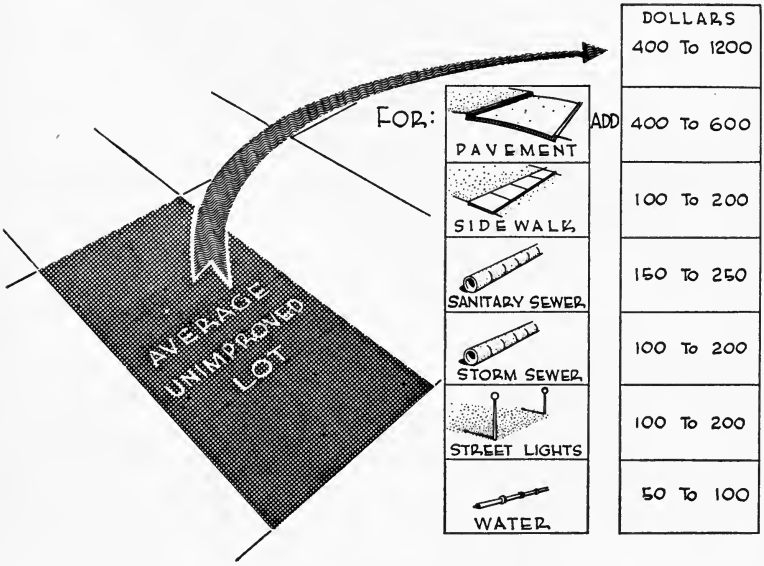

Figure 159. Improvements add to the value of the lot and must be taken into account when the location is selected.

fewer improvements are available. Unless improvements are already provided, the owner may have to pay individually for them, or special assessments may be required to obtain them in the future.

Neighborhood. People prefer to live in a community of homes that are relatively uniform in quality; among families of similar tastes and incomes; and where good standards of appearance, sanitation, and public facilities are required. Many locations are "restricted" to prevent the building of houses having less than a certain value and also to protect the com-

munity from objectionable activities or commercial and industrial establishments.

Surroundings. Satisfactory transportation, good schools, numerous churches, convenient shopping centers, liberal parks and playground areas are factors in the choice of a location. Trunkline highways, factories, near-by main railroad lines, and sources of offensive smoke and odors should be avoided.

The lot. It is desirable to have a lot large enough for a house, garage, driveway, lawn, and plantings. A 50-foot lot is about the minimum to allow freedom in design of the house; 60 to 90 feet is a better width. Usually the lot should be 100 to 160 feet deep. Small lots should be level or nearly so, but they should be graded for drainage away from the house. On large lots it may be possible to utilize sloping ground to good advantage, and to have terraces, retaining walls, and other landscaping features.

JUDGING A HOUSE

In buying a house already built, it is important to know what to look for as evidences of quality and value. The home can be compared with others in the community. Examined in detail, the strong and weak points become evident; balancing them gives a basis for judgment.

It is natural on first inspection to give the most emphasis to the parts of the house that can be seen. Paint, decoration, and minor repairs may give an attractive appearance but at the same time may hide defects. Often the real value of the house is in the foundation, framing, bracing, insulation, and other hidden parts.

If the house is relatively new, it can be valued by comparison with other new houses, and by checking the materials, construction, equipment, and finish against good plans and specifications. The reputation a contractor has for building good houses is one assurance of quality. Talk to a lending agent about financing the house; he must know values in the community. Engineers, architects, materials dealers, and others familiar with house building are in a position to give advice.

Even in a newly built home, the value can be judged by examination. The absence of weaknesses, defects, and unsatisfactory

qualities, are indications of good construction and reliable workmanship. Plaster cracks, floors that vibrate when walked on, leaks around chimneys, water in the basement, and wavy glass in windows are evidences of weakness or cheap construction that can be noted readily. Close inspection may reveal undersized floor joists, inadequate wiring, and lack of insulation which indicates

Figure 160. Although two houses may be similar in structural quality, one may be far less desirable because of poor taste in details. Good design may be ruined by ill-planned substitutions.

poor quality. Has the builder "skimped" on closet space, shelving, cabinets, screens, and even in the size of rooms?

When considering a house for purchase, it is essential also to find out about tax assessments, zoning laws, special taxes, available utilities, and mortgages or liens against the house. Such facts, together with neighborhood factors of location, transportation, and character of surroundings are helpful in estimating the value of a house.

Old houses are more difficult to judge. A house may be obsolete

because of poor location, a small lot, or a "dated" appearance. Often the plumbing fixtures, cabinets, door and window trim, or the heating system are out-of-date or inadequate by today's standards. Depreciation occurs over the years as mortar deteriorates, nails rust, paint wears off, floors become marred, and leaks develop in the roof. Many defects can be overcome by repairing and remodeling. Others caused by decay and deterioration are not visible and are found only when repair work is begun.

If an old house has a firm foundation, rigid framework, level floors, and straight walls and does not show evidence of sagging or decay, it can usually be repaired or remodeled. Then the important point to decide is whether or not the desired improvements and changes can be made economically (see Chapter 8).

The original cost of a house bears little relationship to present value. When prices are rising, depreciation may be offset by higher present value; with downward price trends, a house may sell for much less than its calculated value.

Some facts needed for judging a house can be found only by experience or by making inquiries. Is the basement dry? Is the house comfortable in summer? Is it hard to heat in winter? Does the roof leak? Does the fireplace heat the room without smoking? An item-by-item analysis is the only certain basis for judging and evaluating an old house. A simple rating scale such as the following might be used as a general guide:

Good—no defect; generally good; only minor repairs needed.
Fair—usable but in need of improvement and repair.
Poor—needs extensive repair, renewal, or complete replacement.

The foregoing rating may be applied to each of the principal parts such as foundation, floor, frame, walls, ceilings, flues, roof, doors and windows, plumbing, heating, and wiring. The "good–fair–poor" rating might also be applied to size of rooms, kitchen arrangement, closet space, stairs, hallways, and other parts of the plan. If as many as one-half the parts are rated "poor," the entire house would be of doubtful value. A farm housing survey made in 1934 by the U. S. Department of Agriculture indicated that less than one-half the structural parts of farmhouses were in good condition on the average. (The "score" was 44 on the basis of a possible 100.)

APPENDIX A

Housing Problem Study

What is done about housing depends largely on current events, economic conditions and local situations. Intelligent choices can be made only if ample information is utilized. Full understanding of housing problems and their solution requires a study of conditions and needs in the community, planning aids and resources, and a knowledge of prevailing costs, styles, materials, and methods of construction. Housing study cannot, therefore, be limited to textbooks and basic facts, but in addition, it involves current and local information pertaining to housing.

The problems assigned in a housing course will vary with the time available, the student's interest and need, and the objectives of the study. Each teacher will wish to build up a series of assignments consistent with the course. The problems suggested here have been found useful in college courses.

Types of problems. The scope of housing study may vary from brief routine assignments to be prepared in the library or from reference material to individual or special studies worthy of a graduate thesis. Frequently students are faced with personal housing problems of planning or making home improvements for themselves or their families. Such situations offer excellent opportunities for organizing and applying information to a specific case. Planning problems, outlined early in a course may be developed step by step as the subject matter is studied.

Conditions and needs. Much of the public interest in housing is the result of conditions that need improvement or of demands that remain unfilled. In addition to current publications, reference should be made to Colean's "American Housing," the U. S. Department of Agriculture's Miscellaneous Publication 323, "The Farm

Housing Survey," and the "President's Conference on Home Building and Home Ownership." Prepare one or more reports on conditions, costs, supply and demand, deficiencies and needs in housing. Also study the public programs, and public services that apply specifically to housing.

Local housing situations. The local community provides excellent resources for a study of immediate problems of building homes, financing, observing restrictions and regulations, overcoming bad situations, and making necessary contacts. In most communities, the best information on such problems can be obtained by consultation with local authorities, by reviewing publications available locally, or by making personal studies and observations. Suggested sources are banks, building and loan associations, architects, contractors, materials and equipment dealers, building inspectors, city departments or commissions, "housing authorities," and city planning boards. Typical problems for study include: the condition of housing in various parts of the community, the local building code, restrictions that apply in subdivisions, inspection requirements, the zoning system, health and fire hazards, insurance rates, and current building activity and costs.

Assembling resources for planning. Planning aids are available from many sources, both public and private, and locally as well as nationally. These aids are in such form as color cards at the paint store, catalogs from manufacturers, instruction books, public bulletins, and samples of materials. Often permanent or temporary displays, exhibits, clinics, or advisory services are available in the community. Suggested studies include lists of planning aids, collections of samples, assembly of exhibit materials, and preparations of reports on free, low-cost, or professional planning assistance.

Preparing programs for housing activity. Employment opportunities in home economics include many positions in which housing may be an important part. These include home service work; advisory services with stores, banks, or contractors; research; public extension service; home demonstration work; and vocational teaching. Advanced study may include the organization of suggested programs for housing in any of these lines.

Include objectives, references, planning aids, subject matter, and activities involved in these programs.

House planning. Planning studies may follow any one of several lines of interest. In some cases, the problem may be made to cover the complete development of a house, from an analysis of requirements to the preparation of finished plans. Generally it is preferable to study various aspects separately, in order to explore the details of such subjects as kitchen design, room requirements, plan patterns, space needs, closet and storage space, and alternate arrangements.

Remodeling. Improvement of existing houses is a common need and offers many opportunities for improvement by replanning, adding needed facilities, making repairs, and modernizing. Using a house in the community as an example, develop a complete remodeling program. This will include "before" and "after" plans, sketches of proposed changes, and narrative descriptions of finishes, materials, and equipment.

Structure and materials. To avoid details that concern only the builder, craftsman or technician, and yet understand typical construction methods and material use, it is necessary to study problems such as the following: vocabulary of terms used to designate the parts of the structure; the purposes of the structure (strength, fire safety, durability, economy, and the like); comparison of costs and values of various materials; comparison of on-site and prefabricated construction; study of grades, compositions, kinds, and classes of materials and their relative values; selection of materials; preparation of specifications; and accumulation of samples of materials.

Equipment. Installing equipment is strictly a craftsman's job, and designing equipment requires more than average engineering ability. Thus, the principal problem study should be concerned with the selection of styles, finishes, or kinds of equipment and utilities and their co-ordination in the plan. Other references should be consulted. Pertinent problems for study include: (1) planning the bathroom and selecting the fixtures, (2) listing the requirements for water supply, such as heater, softener, and piping; in the case of a farmhouse, determine the source of supply and capacity of the system, (3) planning the lighting

and location of lights, switches, and convenience outlets, and (4) comparing the values and features of the available types of house heating equipment.

Costs and quantities. The cost of a house is influenced primarily by local requirements, wage scales, material prices, and economic conditions in the community. General estimates can be made on the basis of local information from which the cost per room, per cubic foot, or per square foot can be determined. Apply these estimates to several plans. Since houses normally cost about double the cost of the materials (this varies too by communities), a close estimate may be made by calculating the materials needed for a given house. To do this, it is necessary to make a list of current prices, find and apply rules or formulas for figuring commercial units of material, and learn how to calculate the quantities needed for the particular plan.

Business problems of housing and house ownership. A wide variety of conditions, situations, and circumstances confront the prospective home owner, and thus create many problems that deserve study. The major considerations relate to the family's financial resources, determining costs, selecting a site, judging old houses, purchasing property, consulting with local business and professional organizations (banks, architects, realtors, contractors, and dealers), arranging for loans and repayment, understanding contract documents, and comparing values.

Each of the foregoing problems may be divided into many specific phases. For example, it may be desirable to study such details as zoning laws, building codes, financing methods, annual costs, owning versus renting, city and community growth, and the differences between rural and urban housing.

APPENDIX B

References for Housing Study

To keep up-to-date on current housing developments and to obtain detailed information on house design, planning, materials and equipment, it is necessary to utilize reference books, bulletins, periodicals, and trade and industry publications. Much information can be obtained free or for a nominal charge. General references are to be found in college and university libraries; a complete array of publications is maintained in libraries of architectural and technical schools. The list that follows includes material selected especially for women students. Because of the wide range of interest among readers, the sources of information are listed, rather than specific titles or publications where listings change frequently. Inquiry in each case will bring information on currently available publications. Only the principal trade associations and representative periodicals of interest in connection with housing are listed.

GENERAL REFERENCES

"Sweet's Architectural Catalog." (Sweet's Catalog Service, F. W. Dodge Corporation, 119 West 40th St., New York, N. Y.) This annual publication is not available for general distribution, but copies are supplied to most architects, building contractors, college and university libraries, and to many lumber dealers. Arrangements can usually be made to consult current issues for detailed information on building materials and equipment.

"Architectural Graphic Standards." A comprehensive reference on design, structural standards, space requirements, and basic information for the architect and designer. Published by John Wiley & Sons, Inc., New York, N. Y., 1941.

"Time Saver Standards." A complete reference book for the

architect, engineer, designer, and contractor, which covers information needed in plan and design of houses, apartments, and business or industrial buildings. Published by the F. W. Dodge Corporation, New York, N. Y., 1946.

"The President's Conference on Home Building and Home Ownership." Edited by John M. Greis and James Ford, and distributed by Better Homes, Purdue University, Lafayette, Ind. The reports, published in 11 volumes are no longer available for sale. Consult libraries for copies. Although published in 1934, the conference reports are exceptionally useful in a study of housing problems and needs.

The Small Homes Council of the University of Illinois. This is a university-wide organization for education, research, and publication. Of most direct interest is the series of illustrated bulletins on subjects of housing. Typical titles are "Insulation," "Septic Tank Systems," "Selecting a Livable Neighborhood," "Solar Orientation," and "Designing the Home." Address the Small Homes Council, Urbana, Ill., for information on titles and cost.

STATE AND FEDERAL PUBLICATIONS

Among the public agencies that provide information relating to housing, the following are of the most direct interest to students:

SUPERINTENDENT OF DOCUMENTS, Government Printing Office, Washington D.C. The printing office supplies bulletins, booklets, and miscellaneous publications prepared by the various Government departments but which are not available without charge.

HOUSING AND HOME FINANCE AGENCY, Public Housing Administration, Washington D.C. Provides information on financing, construction requirements, technical data, and results of research from various sources.

U. S. DEPARTMENT OF AGRICULTURE, Washington D.C. The principal Government source of bulletins and circulars covering many phases of home planning, construction materials, equipment, finishes, and furnishings. Of interest to home owners generally, but intended especially for farm families. The Forest Products Laboratory, Madison, Wis., which is a part of the U. S. Department of Agriculture publishes popular and technical information on wood, wood products, and preservative treatments.

THE COLLEGE OF AGRICULTURE. Each land-grant college or university having a college of agriculture is a source of planning aid and information. The organizations include county extension agents, specialists in the extension service, and experiment stations. Inquiry in each state will bring information on available plans and publications. Some universities both in the United States and Canada maintain institutes, councils, or bureaus organized to conduct research and issue publications in the field of housing.

BOOKS

Following is a brief list of relatively recent books which have been found useful in teaching housing courses:

AMERICAN PUBLIC HEALTH ASSOCIATION, COMMITTEE ON THE HYGIENE OF HOUSING, "Planning the neighborhood." Public Administration Service, Chicago, Ill., 1948.

ARNOVICI, CAROL, "Housing the Masses." John Wiley & Sons, Inc. New York, N. Y., 1941.

CARTER, DEANE G., and W. A. FOSTER, "Farm Buildings." John Wiley & Sons, Inc., New York, N. Y., 1941.

COLEAN, MILES L., and ASSOCIATES, "American Housing." Twentieth Century Fund, New York, N. Y., 1944.

DALZELL, J. RALPH, and GILBERT TOWNSEND, "How to Remodel a House." American Technical Society, Chicago, Ill., 1942.

PICKERING, ERNEST, "Shelter for Living." John Wiley & Sons, Inc. New York, N. Y., 1941.

SLEEPER, HAROLD R. and CATHARINE, "The House for You," John Wiley & Sons, Inc., New York, N. Y., 1948.

TOWNSEND, GILBERT, and J. RALPH DALZELL, "How to Plan a House," American Technical Society, Chicago, Ill., 1942.

TRADE ASSOCIATIONS

American Gas Association, 420 Lexington Ave., New York, N. Y.

Asbestos–Cement Products Association, 16th Floor, Inquirer Bldg., Philadelphia, Pa.

Asphalt Roofing Industry Bureau, 2 W. 45th St., New York, N. Y.

Copper and Brass Research Association, 420 Lexington Ave., Chicago, Ill.

Douglas Fir Plywood Association, Tacoma Bldg., Tacoma, Wash.

Gypsum Association, 211 W. Wacker Drive, Chicago, Ill.
Institute of Boiler and Radiator Mfgs., 60 E. 42d St., New York, N. Y.
Insulation Board Institute, 111 W. Washington St., Chicago, Ill.
Lead Industries Association, 420 Lexington Ave., New York, N. Y.
National Adequate Wiring Bureau, 155 E. 44th St., New York, N. Y.
National Door Manufacturer's Association, 332 S. Michigan Ave., Chicago, Ill.
National Lumber Manufacturer's Association, 1337 Connecticut Ave., N. W., Washington, D. C.
National Oak Floor Manufacturer's Association, 830 Dermon Bldg., Memphis, Tenn.
National Paint, Varnish and Lacquer Association, 1500 Rhode Island Ave., Washington, D. C.
National Retail Lumber Dealer's Association, Union Trust Bldg., Washington, D. C.
National Warm Air Heating and Air Conditioning Association, 145 Public Square, Cleveland, Ohio.
Plumbing and Heating Industry Bureau, 35 E. Wacker Drive, Chicago, Ill.
Portland Cement Association, 33 West Grand Ave., Chicago, Ill.
Producer's Council, 122 East 42d St., New York, N. Y.
Structural Clay Products Association, 1756 K St., N.W., Washington, D. C.
Wallpaper Institute, 19 W. 44th St., New York, N. Y.

Index

Abstract of title, 244
Accident prevention, 147
Acquiring a home, 239, 243
Adapting basic plans, 48
Additions in remodeling, 114
Advantages of home ownership, 241
Agencies, public housing, 24
Aids in planning, 33
Air conditioning, 146
Amortization, of loans, 236
  schedule, 237, 238
Analyzing plans, 55
Anchors, 185
Annual cost of housing, 232
Appearance, factors affecting, 102
Approximate costs, 216
Arrangement of kitchen, 71
Assessments, 231
Attic, 95

Basement, 96
  depth of, 161
Basic plan, measurements, 159
  requirements, 44
Bathroom, 83
Bathrooms, divided, 84
Bedrooms, 81
Blueprints, 33
Board measure, 224
Books, reference, 259
Borrowing, for home financing, 233
Bracing, 185
Bridging, 183
Building and loan associations, 234
Building, codes, 11
  materials, 192, 219
  paper, 206
  permits, 12
  sheets, 201
Business, center in farmhouse, 130
Business, contacts to make, 242
  problems of building and buying, 242

Calculated house cost, 215
Calculating costs, 222
  lumber, 224
Ceiling height, 163
Chimney and fireplace, location, 99
  construction for fire safety, 153
Choices in housing, 5
Choosing building materials, 193
Closets, 86
Codes, 11
Comfort, standards for, 150
Common board lumber, 197
Comparison, plan features, 54
  urban and farmhouses, 125
Concrete, 200
Conditions, farm housing, 15, 18, 19
  housing, 13
Control of moisture, 155
Construction, conventional, 176
  prefabricated, 172
  types of, 170
Contract documents, 245
Contracts, 244
Controls, public, 10
Conventional constructions, 176
Cornice, 187
Cost, calculation, 215, 222
  factors, 211
  guides, 214
  trends, 211
  units, 216, 218
Costs, 208
  approximate, 216
  precise, 218
  ways to reduce, 213
Cubic foot unit cost, 218
Cutouts, 37, 169

Decking, 187
Deed, 244
Defects, structural, 189
Definition of house parts, 182
Delineation of plans, 38
Depreciation, 232
Describing materials, 195
Dimension lumber, 197
Dimensions, 40
Dining room, 78
Disposal of sewage, 142
Documents, contract, 245
Don'ts in planning, 50
Doors, and doorways, 101
  garage, 98
  sizes of, 168
Dormers, 187
Drain, foundation, 187
Drawings, 33, 38

Electric service, 136
Emergency housing, 21
Enclosing materials, calculation of, 222
Equipment, kitchen, 60, 69
  planning for, 135
Errors of planning, 50
Estimating annual costs, 232
Estimating building cost, 215, 222
Evaluation of house for remodeling, 110
Excavating, 179

Facilities for hygiene, 140
Factors affecting appearance, 102
Facts needed for remodeling, 111
Farm credit, 235
Farmhouse, conditions, 15, 18, 19
  location, 132
  plan features, 127
  planning service, 26, 134
  requirements, variations, 122
Farmhouses, compared to urban, 125
Federal Home Loan Bank Board, 24
Federal Housing Administration, 24
FHA loans, 234
Financing a home, 233
Finish lumber, 198
Fireplace, location, 77
  plan, 100
Fire safety, 151
Flashing, 187
Floor levels, number, 91
Flues, construction of, 180
Footing, 161, 187
Foundation, 187
  height, 108
  staking out, 178
Frame parts, 183
Framing, 180
Functional value, definition, 3
Furring, 187

Garage, 97
Girder, 183
Goals, housing, 2
Guides to house cost, 214
Gutters, 187

Headers, 183
Health safeguards, 149
Heating systems, 142
Height, of ceilings, 163
  of foundation, 108
  of kitchen equipment, 65
  of openings, 164
  of work surfaces, 66
Home financing, 233
Homemaker's use of time, 2
Home ownership, 239
  cost of, 230
Home Owner's Loan Corporation, 24
House, areas according to use, 44
  costs, 208, 211
  frame types, 183
  framing, 180
  heating, 142
  parts, definition of, 182
  planning approach, 44
  plans personalized, 50
  plans symbols, 40
  remodeling, 109
  site, 247

House, size, 90
structure, 170
styles, 102
wiring, 136
Housing, a public problem, 7
authorities, 27
choices, 5
conditions, 13
control and regulation, 10
costs, 229
deficiencies, 14
emergency, 21
goals, 2
levels of quality, 20
needs, 13
problems for study, 253
public, 22
references, 257
research, 27
sources of information, 26, 257
standards, 17
substandard units, 14
trends, 6
Hygiene, facilities for, 140

Improvement districts, 12
Improvement of housing conditions, 17
Information, public services for, 30
sources of, 13, 26
Introduction, 1
Inspection, for code compliance, 12
for fire safety, 155
for work in progress, 242
Insulation, 187, 202
Insurance, 231
Interest, 232
Investing in a home, 229

Judging houses, 249
Judging plans, 53
Joist, 184

Kitchen, arrangement, 71
concepts, 57
measurements, 64
plan, 68
Kitchen, planning, 57, 61, 66
types, 62
Kitchens, according to arrangement, 63

Legal problems of home ownership, 244
Lettering, 43
Levels of house quality, 20
Lightning protection, 155
Limitations in planning, 3
Listing materials from plans, 225
Living room, 75
Loans, amortization of, 236
building and loan association, 234
FHA, 234
repayment of, 235
security for, 235
Location of farmhouse, 132
Louvers, 187
Lumber, 196
calculation of, 224

Material, lists, 227
units, 219
Materials, building, 192
description of, 195, 219
miscellaneous, 205
Masonry, 200
amounts, 222
units, 222
wall, 188
Measurements, basic, 159
kitchen equipment, 64
on plans, 41
vertical, 161
Methods of improving housing, 21
Models and planning aids, 34
Modular co-ordination, 160
in kitchen planning, 68
Moisture control, 155
Mortar, 201

National Housing Agency, 25

Objectives of public housing, 23
Occupation area, 45

Office in farmhouse, 130
Openings, height of, 164
Ownership, advantage of, 241
  legal aspects, 244
  problems, 239
  resources to justify, 240
  risks of, 241
  ways to acquire, 243
Owning a home, cost of, 230

Paper, building, 206
Parts of house structure, 183
Patterns of house plans, 46
Permits, 12
Personalizing plans, 50
Pictorial drawings, 33
Piers, 188
Pitch of roof, 164
Plan, adaptations, 48
  analysis, 55
  patterns, 46
Planning, aids, 33
  errors of, 50
  limitations, 3
  preferences, 52
  problems, general, 90
  procedure, 7
  resources for, 29
  services, 26
  trends, 48
Plans, definition of, 33
Plate, 184
Plumbing, 140
Plywood, 198
Porches, 98
Posts, 188
Prefabrication, 172
Prevention of accidents, 147
Problems for housing study, 253
Procedure in planning, 7
Program for remodeling, 114
Protective qualities, 147
Publications relating to housing, 257
Public Housing Administration, 25
Public housing, agencies and programs, 24
  information services, 30
Public housing, objectives, 23
  policy, 22
  problems, 7
Purchasing a home, 243

Qualities, protective, 147
Quality levels of housing, 20

Rafters, 185
Recreation area, 44
Reducing house costs, 213
References for housing study, 257
Regulation of housing, 10
Relaxation area, 45
Remodeling, plan changes, 114
  program, 114
  purpose, 109
  sketch plan, 113
Rent—what it pays for, 229
Repairs, 117
Repayment, of loans, 235
  schedules, 237, 238
Requirements, house plan, 44
Research in housing, 27
Resettlement Administration, 24
Resources, for home ownership, 240
  for planning, 29
Restricted subdivisions, 12
Reversing a plan, 48
Roof, pitches, 164
  projection, 108
  shape, 107
  strips, 188
Roofing, 205

Safeguards to health, 149
Scales, for drawings, 39
Security for loans, 235
Selecting a site, 247
Septic tank systems, 142
Services, planning, 26
Sewage disposal, 142
Shapes of roofs, 107
Sheathing, 188
Shingles, 205
Siding, 188
Sill, 163, 185

Similarity of urban and farmhouses, 126
Site, 247
Size, of closets, 86
of doors and doorways, 168
of house, 90
of kitchen equipment, 65
of windows, 168
Small Homes Council, 28
Space allowances in the plan, 169
Specifications, 195
Stairways and steps, 147, 166
Standards of housing, 17
methods of raising, 21
Structural changes, 118
Structural defects, 189
Structural parts, 183
Stucco, 189
Stud, 185
Styles of houses, 102
Subdivision restrictions, 12
Subfloor, 189
Substandard housing units, 14
Symbols used in drawing, 39

Taxes, 230
Tennessee Valley Authority, 24
Termite shield, 189
Time, housekeeping, 2
Tools, drawing, 38
Trade associations, 259
Trade associations, literature, 30
Trends in housing, 6
Types, framing, 183
kitchen, 62

United States, government agencies, 25
Housing Authority, 25
Units of building material, 219
Urban and farm houses compared, 125
Utilities in the farm house, 131

Vapor barrier, 189
Variation, in farmhouse requirements, 122
in house costs, 212
Veneer, 189
Vertical measurements, 161
Veteran's housing loans, 233

Washup space in farmhouse, 128
Waterproofing, 189
Water supply, 140
Windows, 100, 168
Wood products, 198
Workroom, 72
Work surfaces, 66

Zoning, 10

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